Funded by the European Union

MNE-ALB
IPA CROSS-BORDER COOPERATION PROGRAMME
MONTENEGRO-ALBANIA 2014-2020

SKADAR/SHKODER LAKE WATERSHED
A Transboundary Biosphere Reserve

ECOLOGICAL REPORT

CONTRIBUTION TO THE NOMINATION OF SKADAR LAKE WATERSHELD AS A UNESCO BIOPSHERE RESERVE

EDEN Qendra Mjedisore
ENVPRO
AGJENCIA KOMBËTARE E ZONAVE TË MBROJTURA
NATIONAL PARKS OF MONTENEGRO
Ministarstvo javne uprave

This report document was created within the framework of the project: "Skadar Lake Basin – A Transboundary Biosphere Reserve" implemented by the Environment Programme in cooperation with the Public Enterprise for National Parks of Montenegro, the Ecological Center for Development, Education, and Networking (EDEN Center), and the Regional Unit of Shkodra / National Agency for Protected Areas in Albania (NAPA). The project is supported within the framework of the Montenegro-Albania Cross-Border Cooperation Program 2014-2020, Instrument for Pre-accession Assistance (IPA II), and is financed by EU funds.

In support of Environment Programme – EnvPro

Ana Katnić, Executive Director

Author: Milica Kandić, ecology specialist
Contributors: Bojana Mijović, PhD student on Faculty of Natural Science
Mirjana Ivanov, MSc Meteorologist, Institute of Hydrometeorology and Seismology, Montenegro

April, 2025

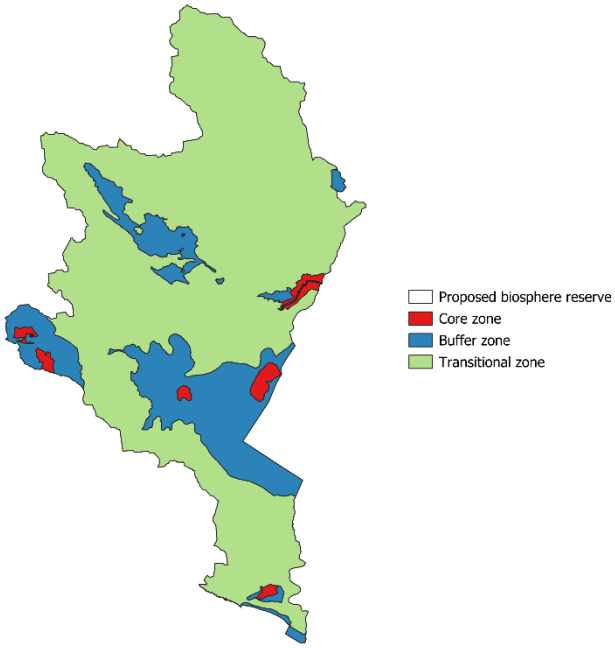
Contents

1. INTRODUCTION

This report contain informations on the **described ecological values and proceses** in the proposed biosphere reserve Skadar Lake Watersheld. Data's are collected based on the available sources: protection sudies, reports, websites, etc.

Proposed biosphere reserve Skadar Lake Watersheld cover folowing protected areas which are core and buffer zones:

- National Park (NP) Skadar Lake
- NP Lovćen
- Nature Park „Dolina rijeke Zete“
- Nature park Komovi
- Nature park Gorica
- Nature park Ulcinj Salina
- Monument of nature Velika Plaža
- Cijevna
- And many other smaler sites - Monuments of nature



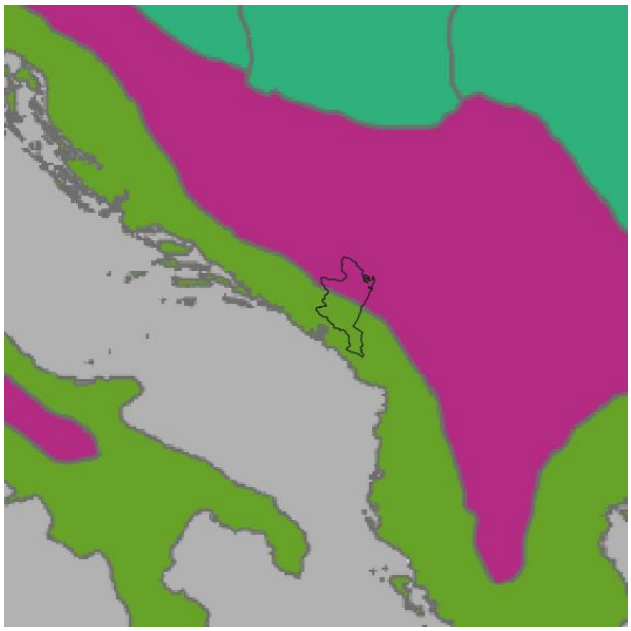
Map 1 – Proposed biosphere reserve Skadar Lake Watersheld

2. BIOGEOGRAPHIC REGIONS OF THE PROPOSED BIOSPHERE RESERVE

Udvardy's biogeographical classification from 1975 is one of the most significant systems for classifying biogeographical regions on a global scale. This classification was developed by Miklós Udvardy, a Hungarian-American biogeographer and ecologist, with the aim of creating a unified framework for nature conservation and biodiversity protection. The system was primarily developed for the International Union for Conservation of Nature (IUCN) and is widely used in global conservation strategies.

The classification is primarily based on a combination of climatic, ecological, and biogeographical factors, with the goal of clearly identifying natural units that share similar ecological characteristics and evolutionary history.

According to this classification, the area of the proposed biosphere reserve belongs to the **Palearctic biogeographical region**, specifically the **Mediterranean bioprovince**, represented by evergreen sclerophyllous forests, and the Balkan Mountain bioprovince, characterized by mixed mountain systems.



Map 2 - Udvardy's biogeographical classification from 1975 and Proposed Biosphere Reserve
The proposed Biosphere Reserve falls within Udvardy's Palearctic biogeographical realm (highlighted in pink) and specifically within the Mediterranean bioprovince (highlighted in green).

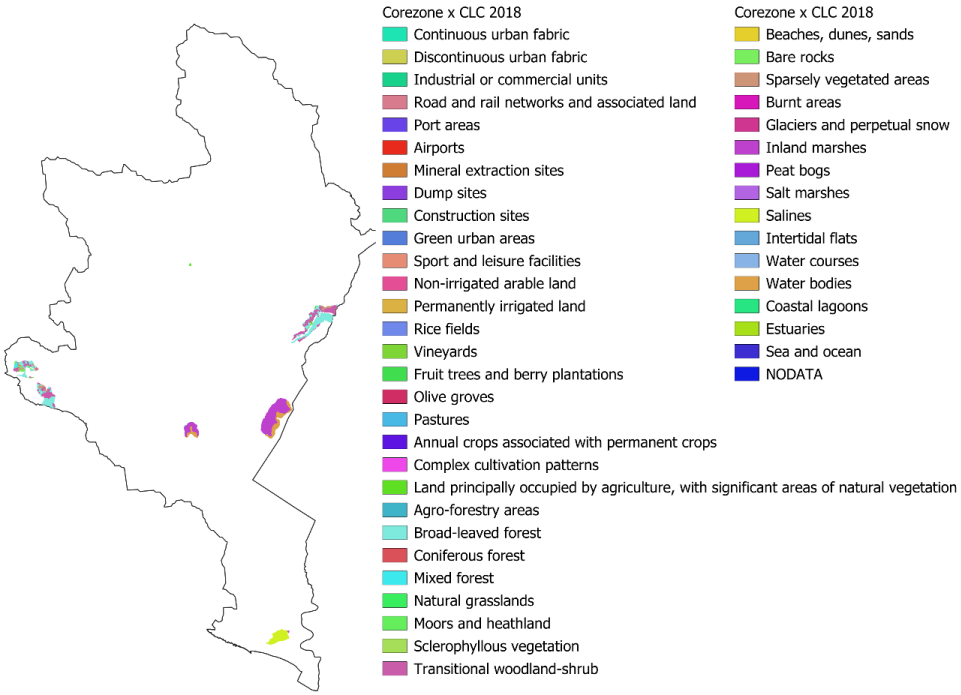
3. NATURA 2000 SITES IN PROPOSED BIOSPHERE RESERVE (BR)

Montenegro is in the process of establishing its Natura 2000 network, aligning with the European Union's directives on habitat and bird protection. This initiative aims to safeguard the country's rich biodiversity, encompassing various species and habitats of European significance. Based on the information from Environmental Protection Agency, institution that led the process of establishing the N2000, data's for the proposed area of biosphere reserve have not been fully verified, harmonized, or technically finalized. The process of mapping N2000 is expected to be completed by mid-2026. The document below outlines areas with international designations such as IPA, IBA, EMERALD, and KBA, which could serve as a strong foundation for the future designation of Natura 2000 sites.

4. LAND COVER TYPE IN PROPOSED BIOSPHERE RESERVE

This analysis provides insight into the structure of land cover types based on the CLC 2018 dataset. The analysis was conducted for all three zones of the potential biosphere reserve (Core, Buffer, and Transitional zones).

4.1. Land type in Core zone



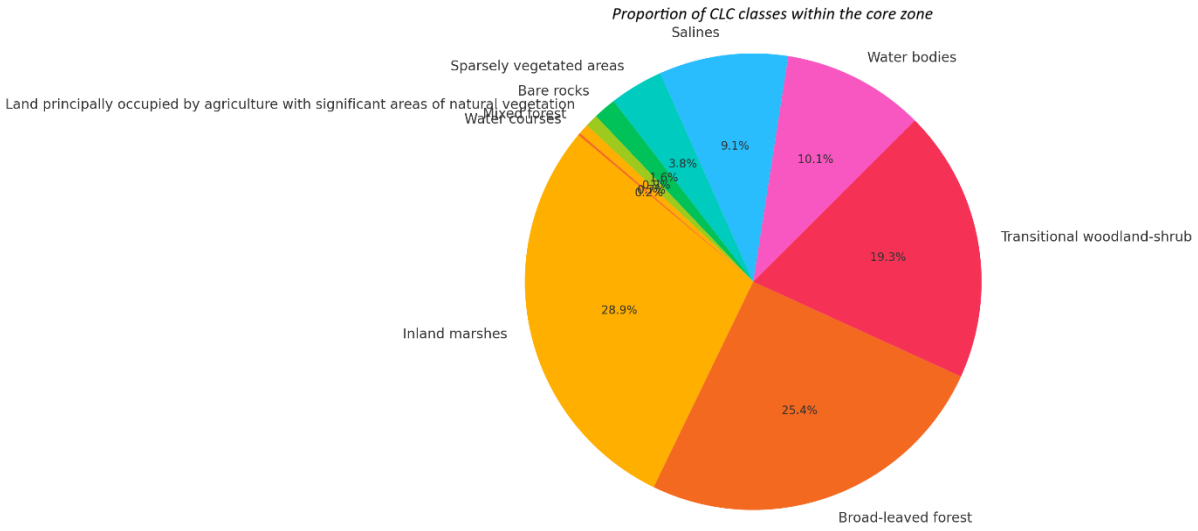
Map 3 – CORINE LAND in Core zone of proposed biosphere reserve Skadar Lake Watersheld

The core zone of Lake Skadar represents the most preserved and ecologically significant part of the biosphere reserve, where natural ecosystems dominate with minimal anthropogenic impact. The total area of the core zone is **6525,71ha** The most represented CLC classes within the core zone are:

411 Inland marches 1886.05 (29 %)
311 Broad-leave forest 1653.31 (25.34%)
324 Transitional woodland - shrub 1257.88 (19.28%)
512 Water bodies 656.37 (10.06%)
422 Salines 595.24 (19.12%)

Corine Land 2018 in the Core zone in proposed Biosphere reserve							
NP Skadar lake		**National park Lovćen**			**Nature park Rijeka Zeta**	**Monument of nature Cijevna River Canyon**	**Velika Plaža – Long beach Ulcinj**
Manastirska tapija (545,42ha)	Rezervat Pančeva oka (1.995 ha)	I zone of protection (689,5 ha)	Nature reserve (25 ha)	I zone of Protection and Special reserve 863,13ha	- I protection zone (17 ha)	- I protection zone (1.783 ha)	609.23 ha
Water bodies (CLC 382,67) – Salt marshes and wetlands (CLC 512) – 152,18ha Wetlands (CLC 511) – 10,57ha	Water bodies (CLC 411) – 1490,86 Salt marshes and wetlands (CLC 512) – 504,19ha	Forest areas (**CLC 311) –** 272.88 ha Shrubland (**CLC 324**) – 170.15 ha Mixed forests (**CLC 313**) – 6.4% 47.48 ha Agricultural mosaic (**CLC 243**) – 2.5ha Scree covered areas **(CLC**	Forest areas (CLC 311) – 6.6 ha Shrubland (CLC 324) – 9.72 ha Agricultural mosaic (CLC 243) – 25.- 8.55 ha	Forest areas (CLC 311) 311 – 450.81 ha Shrubland CLC 324 – 329.8 ha Sparsely vegetated areas CLC 333 – 79.27 ha	Agricultural mosaic (CLC 243) – 100.0%	Forest areas (CLC 311) – 51.8% 923.01 ha Shrubland (CLC 324) – 42.0% 748.21 ha Agricultural mosaic (CLC 243) – 1.8% 30,79ha Sparsely vegetated areas (CLC 333) – 77,7ha	243 – 1.46 ha Strong humid meadows where hygrophyle plant species cover at least 25 % of the parcel CLC 411 – 12.52 ha Coastal saline CLC 422 – 595.24ha

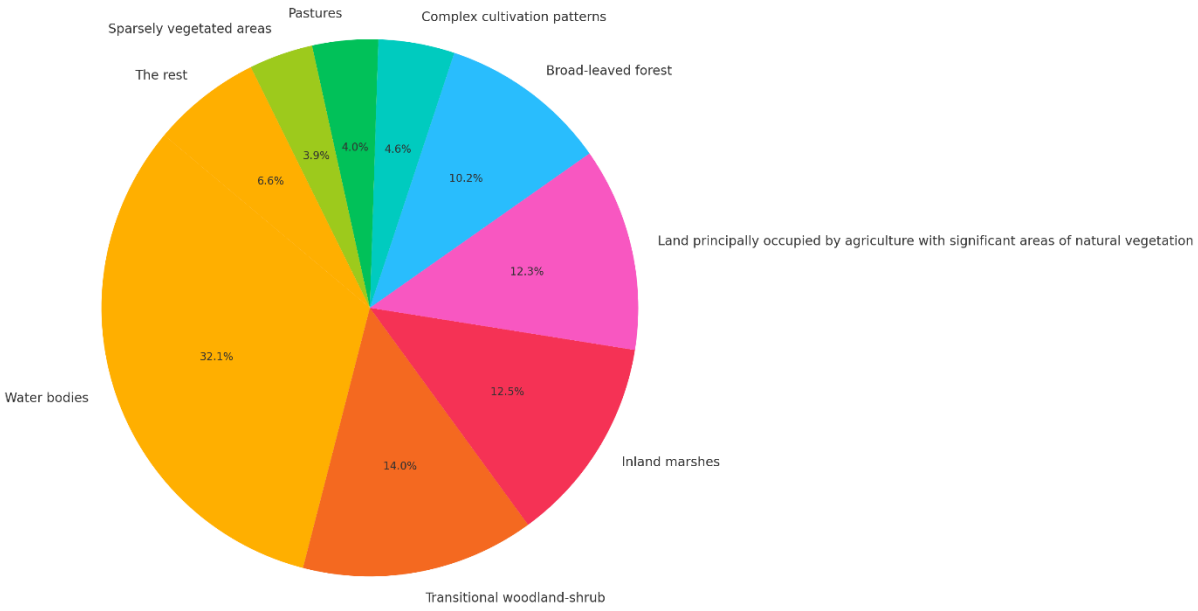
		332) – 104.64 ha Sparsely vegetated areas (**CLC 333) –** 90.84 ha					



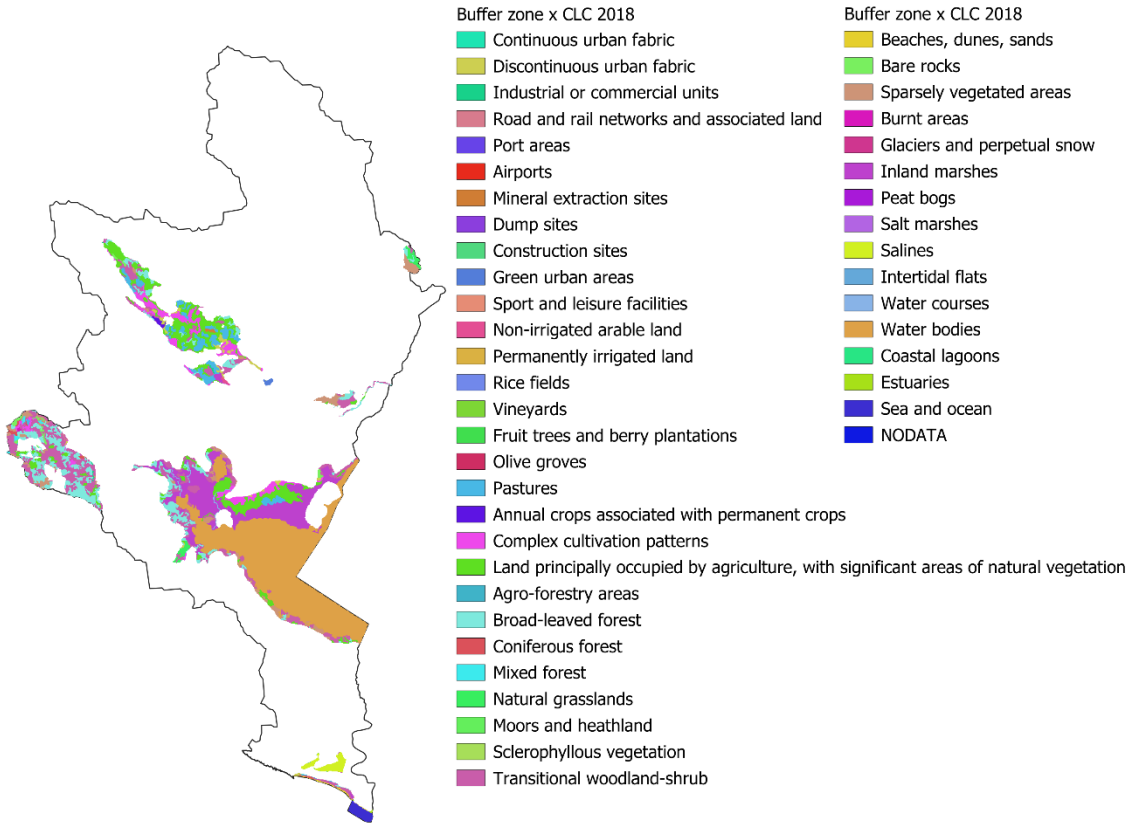
4.2. Land type in buffer zone

Based on data obtained from GIS analysis, the buffer zone is represented by a total of 27 CLC classes. However, in the text bellow are listed classes with the highest percentage representation in the buffer zone:

512 **Water bodies** 21150.14 (32.04%)
324 **Transitional woodland shrub** 9250.93 (14.01%)
411 **Inland marches** 8204.56 (12.43%)
243 **Land principally occupied by agriculture, with significant areas of natural vegetation** (12.14%)
311 **Broad-leaved forest** 6693.11 (10.14%)
242 **Complex cultivation patterns** 3024.91 (4.58%)
231 **Pastures** 2609.33 (3.95%)
333 **Sparsely vegetated areas** 2541.83 (3.85%)
422 **Salines** 788.34 (1.2%)



Water bodies are the most extensive land cover type within the buffer zone, covering an area of 21,150.14 hectares. These aquatic ecosystems are ecologically significant, serving as critical habitats for waterfowl and supporting numerous rare plant species. The second most prevalent land cover is transitional woodland-shrub, spanning 9,250.93 hectares. Inland marshes, covering 8,204.56 hectares, and broad-leaved forests (6,693.11 hectares) also represent vital natural resources, contributing significantly to the ecological integrity of the buffer zone. Additionally, salines, which occupy 788.34 hectares, enhance the area's biodiversity and further enrich the overall ecosystem diversity of the proposed buffer zone.



Map 4– CORINE LAND in Buffer zone of proposed biosphere reserve Skadar Lake Watersheld

Corine Land 2018 in the buffer zone in proposed Biosphere reserve						
NP Skadar lake	**NP Lovćen**	**Nature park Rijeka Zeta**	**Monument of nature Cijevna River Canyon**	**Nature park Komovi**	**Nature park Ulcinj Salina**	
Total area: 40,487.99 ha ---------- Water bodies (CLC 511) – 257.31 ha Free water space in wetlands (class 512) - 21150.14 ha	Total area: 9653.5 ha ---------- Transitional woodland/shrub (CLC 324)– 3893.13 ha Forest areas (CLC 311) – 3431.73 ha	Total area: 11981.25 ha --------- CLC 112 – 553.6 ha CLC 121 – 40 ha CLC 131 – 63 ha CLC 211 – 67.6 ha	Total cover: 1056.67 ha ---------- Forest areas (CLC 311) – 258.12 ha Land principally occupied	Total area: 759 ha ---------- Forest areas (CLC 311) – 102.27 ha Natural grasslands (CLC 321) – 277.5 ha Orchards and vineyards (CLC	Total area: 812.48 ha ---------- Natural grasslands (CLC 321) – 46.0% (240 ha) Sand dunes and coasts (CLC 331) – 23.4% (122 ha)	

Wetlands (CLC 411) 8040 ha Natural grasslands (CLC 321) — 281 ha Forest areas (CLC 311) – 7.5% (1851.85) Vegetated areas where the crown cover of the broad-leaved trees is less than 25 % (CLC 324) – 3340.14 ha Discontinuous urban fabric (CLC 112) – 105.84 ha Pastures CLC 231 – 317 ha CLC 242 – 960.24 ha CLC 243 – 3048 ha CLC 332 – 79.18 ha CLC 333 – 1013.4 ha	Agricultural mosaic (CLC 243) 607.19 ha Mixed forests (CLC 313) – 146.42 ha Coniferous forests (CLC 312) – (153.3 ha) Orchards and vineyards (CLC 242) – 291.58 ha CLC 112 – 15.15 ha CLC 121 – 41 ha CLC 122 – 28.78 ha CLC 231 – 38 ha CLC 332 – 262.59 ha CLC 333 – 675.99 ha CLC 334 – 31 ha	CLC 231 – 2211.5 ha CLC 241 – 126.4 ha CLC 242 – 1772.45 ha CLC 243 – 4343 ha CLC 311 – 1025 ha CLC 323 – 3.55 ha CLC 324 – 1369.27 ha CLC 332 – 93.5 ha CLC 333 – 173.92 ha CLC334 – 3.68 ha CLC 411 – 134.77 ha	by agriculture, with significant areas of natural vegetation CLC 243 – 75.26 ha Sparsely vegetated areas 333 – 344.06 ha CLC 324 – 378.87 ha	242) – 20.2% (1,698 ha) Areas with sparse vegetation (CLC 322) – 10.2% (854 ha) Land principally occupied by agriculture, with significant areas of natural vegetation CLC 243 – 0.35 ha Mixed forest CLC 313 – 1.15 ha 324 – 26.77 ha Bare rock 332 – 7.88 ha Sparsely vegetated areas 333 - 334.46 ha	Urbanized areas (CLC 111) – 8.6% (45 ha) Salines CLC 422 – 788.34 ha Inland marches (CLC 411) - 2.43 ha Pastures CLC 231 – 11.12 ha Complex cultivation patterns CLC 242 – 0.64 ha Land principally occupied by agriculture, with significant areas of natural vegetation CLC 243 – 4.87 ha CLC 324 – 5.07 ha	

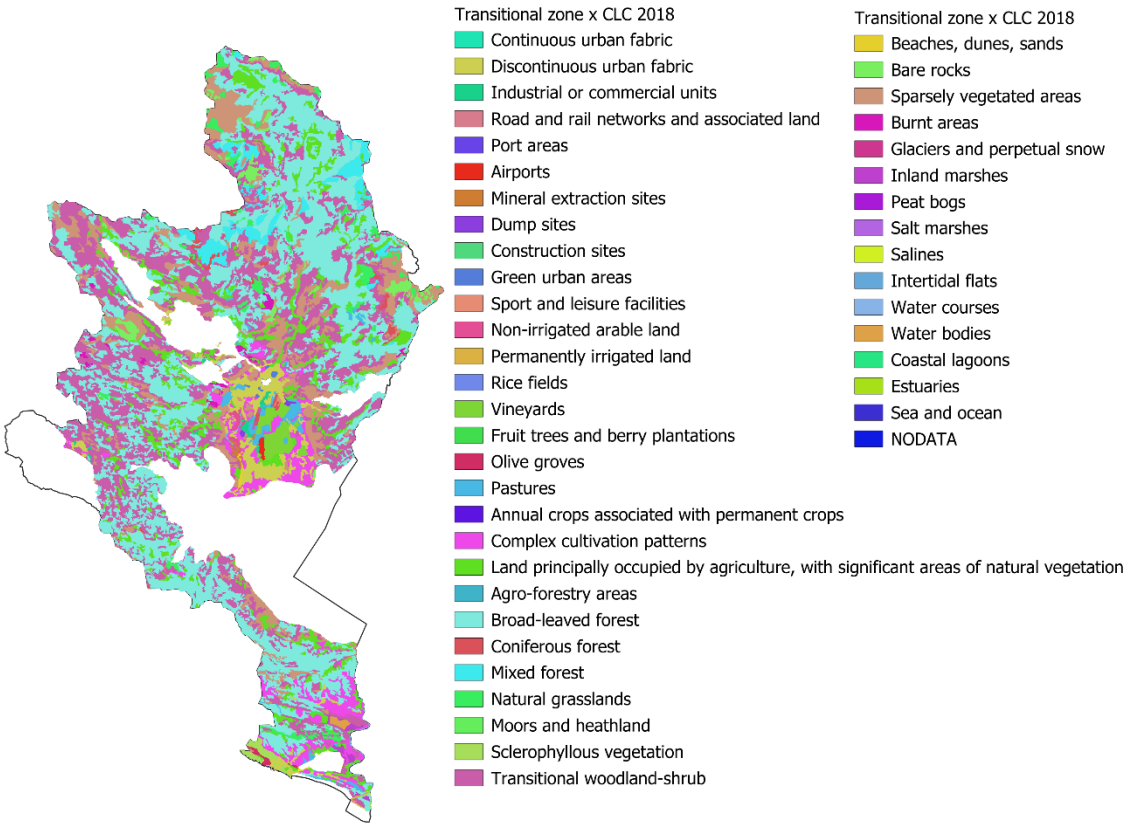
Corine Land 2018 in the buffer zone in proposed Biosphere reserve		
Monument of Nature – Long beach near Ulcinj	**Gorica Forest**	**Marine Buffer Zone of Ada Bojana (620.85 ha)**
Total area: 523,23ha ---------- Grey dunes CLC 331 – 110.38 ha Discontinuous urban fabric CLC 112 – 31.36 ha Sport and leisure facilities CLC 142 – 3.31 ha Pastures CLC 231 – 31.69 ha Broad-leaved forest CLC 311 – 23.76 ha Coniferous forest CLC 312 – 44.2 ha Vegetated areas where the crown cover of coniferous trees is less than 30 % CLC 324 – 237.68 ha Strong humid meadows where hygrophyle plant species cover at least 25 % of the parcel CLC 411 – 27.71 ha Broadening of rivers entering the sea 522 – 0.2 ha	Total area: 104,94ha ---------- Green urban areas CLC 141 – 101.5 ha Discontinuous urban fabric CLC 112 – 3.9 ha	Total area: 620,85ha ---------- Dump sites abandoned and reconverted to leisure areas CLC 142 – 1.75 ha Broad-leaved forest CLC 311 – 0.49 ha Beaches CLC 331 – 15.9 ha Broadening of rivers entering the sea CLC 522 – 15 ha Bays and narrow channel CLC 523 – 574.8 ha

4.3. Land type in transitional zone

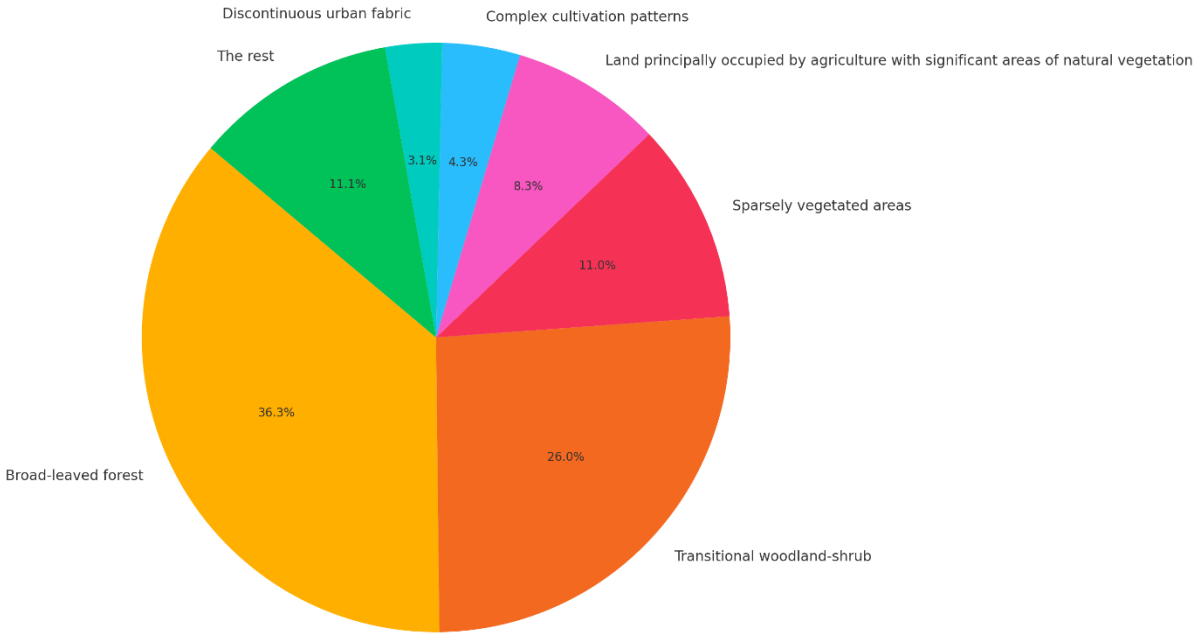
The transitional zone of the proposed biosphere reserve represents the contact area between protected natural ecosystems and anthropogenic influences. This zone is of crucial importance for maintaining ecological balance, as it allows for a gradual transition from undisturbed natural habitats to areas with human activities.

The transitional zone encompasses various land types, including both natural and anthropogenic ecosystems. Within the proposed biosphere reserve, which covers a total area of 274 302 ha , the five most represented CLC classes are:

311 Broad-leaved forest 99403.84 (36.3%)
324 Transitional woodland/shrub 71130.97 (26%)
333 Sparsely vegetated areas 30011.82 (11%)
243 Land principally occupied by agriculture, with significant areas of natural vegetation 22698.13 (8.3%)
242 Complex cultivation patterns 11697.15 (4.26%)



Map 5 – CORINE LAND in transitional zone of proposed biosphere reserve Skadar Lake Watersheld



The dominant land cover type in the area is broad-leaved forest, occupying 99,403.84 hectares or 36.3% of the total surface, highlighting the region's strong forest character. Transitional woodland/shrub follows, covering 71,130.97 hectares (26%), indicating significant areas of regenerating or mixed vegetation. Sparsely vegetated areas make up 30,011.82 hectares (11%), suggesting open or rocky landscapes with limited plant cover. Agricultural land with significant natural vegetation accounts for 22,698.13 hectares (8.3%), while complex cultivation patterns represent 11,697.15 hectares (4.26%), reflecting a mosaic of small-scale farming and natural features.

Corine Land – Proposed Biosphere reserve – three zones		
Core zone	Buffer zone	Transitional zone
411 Inland marches 1886.05 (29 %) 311 Broad-leave forest 1653.31 (25.34%) 324 Transitional woodland - shrub 1257.88 (19.28%) 512 Water bodies 656.37 (10.06%) 422 Salines 595.24 (19.12%)	512 Water bodies 21150.14 (32.04%) 324 Transitional woodland shrub 9250.93 (14.01%) 411 Inland marches 8204.56 (12.43%) 243 Land principally occupied by agriculture, with significant areas of natural vegetation (12.14%) 311 Broad-leaved forest 6693.11 (10.14%) 242 Complex cultivation patterns 3024.91 (4.58%) 231 Pastures 2609.33 (3.95%) 333 Sparsely vegetated areas 2541.83 (3.85%) 422 Salines 788.34 (1.2%)	311 Broad-leaved forest 99403.84 (36.3%) 324 Transitional woodland/shrub 71130.97 (26%) 333 Sparsely vegetated areas30011.82 (11%) 243 Land principally occupied by agriculture, with significant areas of natural vegetation 22698.13 (8.3%) 242 Complex cultivation patterns 11697.15 (4.26%)

Forest ecosystems, specifically broad-leaved forest (36.3%) and transitional woodland/shrub (26%), together making up approximately 77.07% of the land area.

4.4. Trends on changes on ecosystems (using google history, and literature data, or per expert proposal)

Analysis of Corine Land Cover (CLC) Classification Data in Three Protection Zones (Core, Buffer, Transitional) from 1990 to 2018 have been identified significant land use changes over the observed period are summarized in this report. This report provides an overview of key trends, as well as significant increases and decreases in specific land categories over the observed period.

CORE ZONE IN PERIOD 1990 – 2018 – CORINE LAND

Between 1990 and 2018, the core zone underwent significant changes in land cover structure. Some land cover classes disappeared entirely, new ones emerged, and certain classes experienced substantial shifts in their spatial share.

Major Changes:

Disappeared Classes:	**1990**	**2018**
• Olive groves (223): Completely disappeared from the core zone	14.9 ha	0 ha
• Annual crops associated with permanent crops (241):	Also vanished (1990: 53.07 ha;	0 ha
• Coniferous forest (312): :	All areas lost (1990: 11.5 ha;	0 ha).
• Natural grasslands (321):	1252 ha	Not recorded at all in 2018
• Sclerophyllous vegetation (323):	93.66 ha).	Completely disappeared
• Glaciers and perpetual snow (335): .	606.38 ha	No longer recorded
• Peat bogs (412):).	554.79 ha	Not registered

New Classes in 2018:

- Inland marshes (411): Emerged as the dominant class with 1886.05 ha (29%).
- Water bodies (512): 656.37 ha (10.06%).
- Salines (422): A notable new category covering 595.24 ha (9.12%).
- Bare rocks (332): 104.64 ha.
- Mixed forest (313): 48.47 ha.
- Water courses (511): 10.57 ha.

Existing Classes with Major Changes:

- **Broad-leaved forest (311):**
  - 1990: 53.22 ha (0.82%)
  - 2018: 1653.31 ha (25.34%)
  - **Significant increase:** +1600.09 ha
- **Transitional woodland-shrub (324):**
  - 1990: 254.73 ha (3.90%)

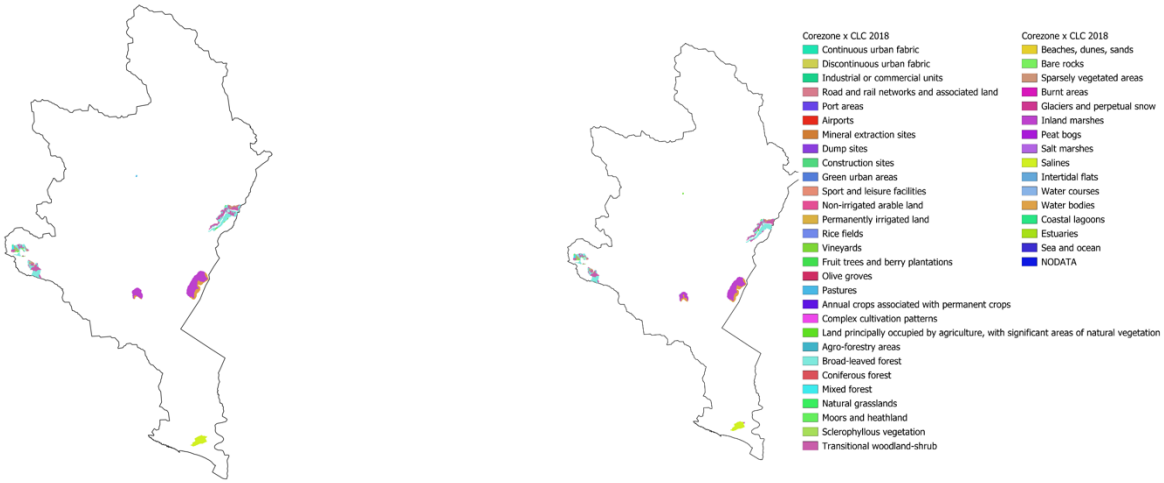
- 2018: 1257.88 ha (19.28%)
- **Marked growth:** +1003.15 ha

- **Sparsely vegetated areas (333):**
  - 1990: 1987 ha (30.44%)
  - 2018: 247.81 ha (3.8%)
  - **Sharp decline:** -1739.19 ha

Notable Specific Change:

- **Land principally occupied by agriculture with natural vegetation (243):**
  - Drastically reduced from 1637.51 ha in 1990 to just 58.42 ha in 2018.

Conclusion - The core zone has experienced dramatic transformations in land cover structure. Previously dominant agricultural areas, natural grasslands, and peat bogs have almost completely disappeared. There has been a rapid expansion of forested areas, particularly broad-leaved forests, and a notable increase in wetlands and water bodies.



Map 6– Corine Land - Changes of ecosystems in core zone – Period 1990 – 2018

BUFFER ZONE IN PERIOD OF 1990 – 2018 – CORINE LAND

Between 1990 and 2018, the buffer zone underwent significant land cover changes, showing a clear trend toward:

- Expansion of water bodies and wetlands;
- Reduction of agricultural land and natural grasslands;

- The emergence of new land cover classes and the disappearance of older ones.

Key Changes:

New Dominant Land Cover Forms in 2018:

- Water bodies (512) became the most dominant class in 2018, covering 21,150.14 ha (32.04%).
- Transitional woodland-shrub (324) and Inland marshes (411) expanded significantly, together covering over 26% of the area.
- Land principally occupied by agriculture with natural vegetation (243) and Broad-leaved forest (311) remain important classes, although both experienced changes in area.

Increases:

- Discontinuous urban fabric (112) saw a substantial increase: from 162.9 ha (0.25%) in 1990 to 709.84 ha (1.08%) in 2018.
- Sparsely vegetated areas (333) and Pastures (231) were still present in 2018, but with reduced shares.
- Salines (422) saw a slight increase in coverage.

Disappeared or Reduced Classes:

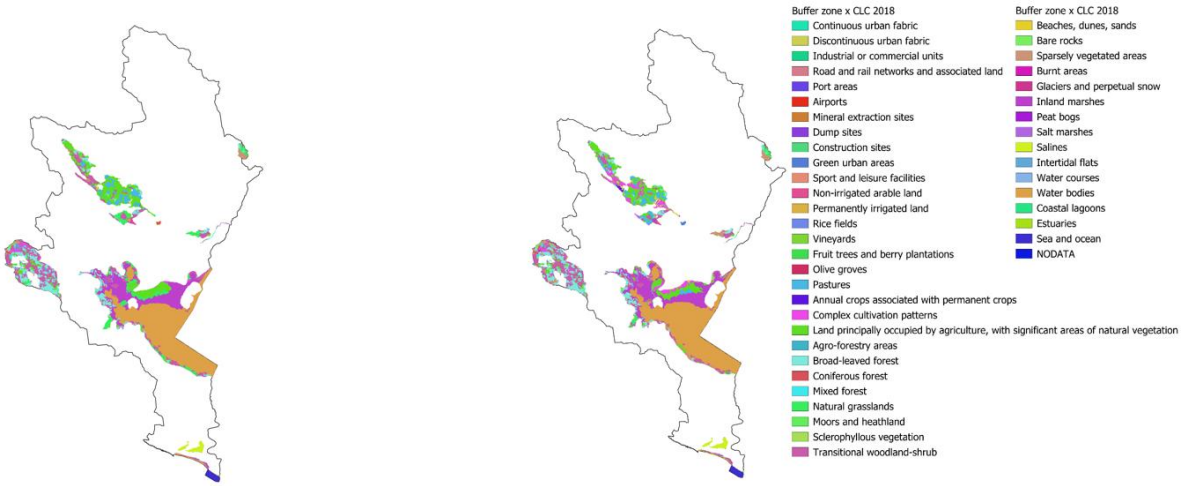
- Olive groves (223): Completely disappeared.
- Fruit trees and berry plantations (222): No longer recorded.
- Glaciers and perpetual snow (335) and Peat bogs (412): No areas recorded in 2018.
- Natural grasslands (321): Drastically reduced from 10,188 ha in 1990 to 558.37 ha in 2018.
- Annual crops associated with permanent crops (241): Declined sharply from 8,120 ha to 126.44 ha.

Emergence of New Classes:

- Water courses (511), Mixed forest (313), Beaches, dunes and sands (331), Green urban areas (141), Sea and ocean (523): None of these classes were recorded in 1990.
- Burnt areas (334) and Estuaries (522) appeared with minor coverage in 2018.

Conclusion:

These changes reflect natural succession processes, land management shifts, and potentially the impacts of climate change.



Map 7– Corine Land - Changes of ecosystems in buffer zone – Period 1990 – 2018

TRANSITION ZONE IN PERIOD OF 1990 – 2018 – CORINE LAND

The Transitional Zone has undergone substantial land cover changes over the past three decades, showing a clear shift toward afforestation, urban and wetland expansion, and a decline in traditional agriculture and natural grasslands.

Key Changes:

Significantly Increased Land Cover Classes:

- Broad-leaved forest (311):
  Increased from 7,791 ha (2.84%) in 1990 to 99,403 ha (36.3%) in 2018 – a massive rise, becoming the dominant land cover class.
- Transitional woodland-shrub (324):
  Grew from 15,685 ha (5.72%) to 71,131 ha (26%).
- Sparsely vegetated areas (333):
  Expanded more than 35 times, from 872.6 ha (0.32%) to 30,011.8 ha (11%).
- Land principally occupied by agriculture with natural vegetation (243):
  Though it decreased from 106,612 ha (38.87%) to 22,698 ha (8.3%), it remains a notable class.

New Classes in 2018:

- Complex cultivation patterns (242): Newly recorded at 11,697 ha (4.26%).
- Bare rocks (332), Burnt areas (334), Water bodies (512), Sea and ocean (523): First recorded in 2018, indicating the emergence of water and degraded land categories.
- Construction sites (133), Beaches, dunes and sands (331): New classes linked to anthropogenic or natural changes.

Classes That Nearly Disappeared:

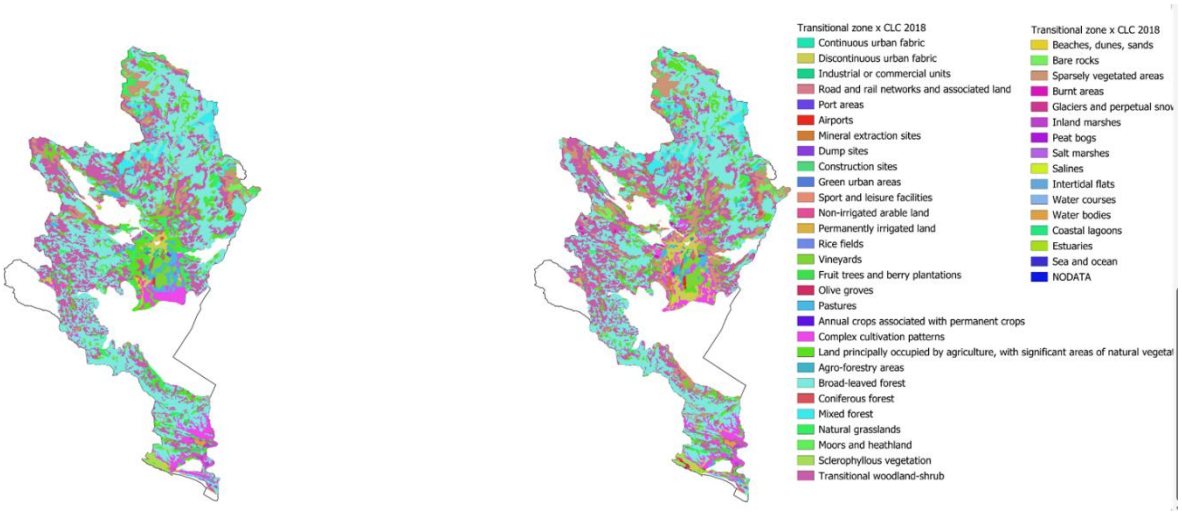
- Natural grasslands (321): Drastically reduced from 70,122 ha (25.56%) to 5,336 ha.
- Annual crops associated with permanent crops (241): Fell sharply from 24,660 ha (8.99%) to just 1.56 ha – essentially vanished.
- Peat bogs (412), Salt marshes (421), Glaciers and perpetual snow (335): No longer recorded in 2018.
- Olive groves (223): Declined from 5,917 ha to 287 ha.
- Fruit trees and berry plantations (222): Completely disappeared (1990: 0.47 ha; 2018: 0 ha).
- Agro-forestry areas (244) and Moors and heathland (322): Not recorded in 2018.

Urbanization and Infrastructure:

- Discontinuous urban fabric (112): Tripled from 2,971 ha (1.08%) to 8,546 ha (3.12%).
- Industrial or commercial units (121): Remained stable at around 639 ha.
- Airports (124) and Roads (122): Slightly increased.
- Construction sites (133): Appeared as a new class in 2018.

Conclusion:

The transitional zone has undergone a profound ecological and functional transformation — shifting from a predominantly agricultural and grassland landscape to a more forested, urbanized, and fragmented environment, marked by significant expansion of vegetation (forests and shrubs), water bodies, and urban areas.



Map 8– Corine Land - Changes of ecosystems in transitional zone – period 1990 – 2018

5. BIODIVERSITY VALUES

5.1. Description of characteristic species (using IUCN status and CITES appendices) in the BR

The richness and diversity of wildlife is a recognized feature of Montenegro, especially if its small area is considered. In the territory of Montenegro about 3600 species and subspecies of wild vascular plants have been recorded (Stešević and Jovović, 2008)[1]. So, according to updated calculation the index of floristic diversity (logS/Log A) of Montenegro is ca. 0.858. In comparison to different regions of tropical, subtropical and temperate zone (Stevanović et al, 1995)[2], this value is rather high, what makes Montenegro one of a biodiversity hotspots of Europe.

The proposed biosphere reserve encompasses a diverse mosaic of ecosystems and unique species. Within this area, there are forests, lakes, rivers, estuaries, canyons, pseudo-steppes, lagoons, salinas, and sand dune systems.

Given that forests cover a significant portion of the proposed reserve, they provide habitat for several characteristic species, including the brown bear (*Ursus arctos*, VU), Eurasian lynx (*Lynx lynx*, LC), and wolf (*Canis lupus*). Additionally, the reserve is home to several local endemic species, such as:

- *Lovćenski zvončić* (*Edraianthus wettsteinii*), found exclusively on Lovćen Mountain.
- *Pinguicula hirtiflora*, a carnivorous plant specific to the Cijevna River Canyon.
- *Gymnospermium scipetarum*, a Montenegrin-Albanian endemic species located on Vrsuta Hill, Rumija Mountain.
- *Petrolamium crnojevici* - is a newly identified plant species and the sole representative of the newly described genus Petrolamium, discovered in 2025. The genus name reflects its occurrence in the karst and wetland ecosystems near Crnojevića River (Montenegro), while the species epithet honors the historical and ecological significance of the region. Morphological and molecular analyses confirm that Petrolamium belongs to the family Lamiaceae, but it is distinct enough to warrant classification as a separate genus. The plant is adapted to periodically flooded habitats and displays a unique combination of floral and vegetative traits not observed in closely related taxa. The discovery highlights the importance of ongoing fieldwork in understudied Balkan ecosystems, which continue to yield taxa new to science.

[1] Stešević Danijela, Jovović, Z. (2008): Plant genetic resources of Montenegro – Medicinal and aromatic plant. University of Montenegro, Biotechnical faculty Podgorica, Podgorica.
[2] Stevanović, V. Jovanović, S., Lakušić, D., Niketić, M. (1995): Diverzitet vaskularne flore Jugoslavije sa predlogom vrsta od međunarodnog značaja. In: Stevanović et Vasić (eds): Biodiverzitet Jugoslavije, sa predlogom vrsta od međunarodnog značaja. Biološki fakultet Univerziteta u Beogradu.

In the proposed biosphere reserve there are a forest of special propose, located in National parks which have a very big importance for nature conservation and climate mitigation. In this context it is worth mentioning forests in NP Lovćen, forest cover 67% of the area (4,189 ha) and represent the dominant ecosystem. Beech forests (*Fagetum montenegrinum montanum*) dominate, present with three *subassociations - F. montenegrinum sesleriesosum, F. montenegrinum viburnetosum, and F. montenegrinum subalpinum*. The endemic species *Pinus heldreichii* (Macedonian pine) grows on the highest peaks – Štirovnik and Jezerski Peak (individually or in groups). Macedonian pine was much more widespread here in the past, but its presence drastically decreased due to logging.

An interesting Balkan endemic species is *Ramonda serbica*, the only poikilohydric flowering plant in proposed biosphere reserve. This species is legally protected and listed in Annex I of the Bern Convention, as well as Annexes II and IV of the Habitats Directive, highlighting its international significance.

The proposed biosphere reserve is home to a large number of protected and rare plant species. In addition to national protection, many taxa within the proposed biosphere reserve enjoy international conservation status and are listed under the European Habitats Directive (HD), the Bern Convention (BC), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the IUCN Red List. Some of these species include *Marsilea quadrifolia*, *Utricularia vulgaris*, *Najas flexilis*, *Caldesia parnassifolia*, and *Lactuca tuberosa*, among others. Species from the *Orchidaceae* family are also included in the CITES list.

Epipactis palustris (L.) Crantz, Serapias lingua L., Serapias vomeracea (Burm. f.) Briq., Anacamptis coriophora (L.) R. M. Bateman, Pridgeon & M. W. Chase. Anacamptis laxiflora (Lam.) R. M. Bateman, Pridgeon & M. W. Chase are plant species that are located also in proposed biosphere reserve and are listed on CITES list with LC IUCN status.

The ichthyofauna is characterized by a relatively high degree of endemism this is spatially in NP Skadar lake. Due to its warm, shallow waters and large surface area, the lake is classified as cyprinid, meaning that fish from the Cyprinidae family (carps and minnows) dominate its waters. However, the hydrological and biological characteristics of its tributaries, particularly the presence of sub-lacustrine springs (underwater springs) with distinct physico-chemical properties, allow for the presence of salmonid fish (trout and related species). The proximity of the Adriatic Sea and the relatively short connection via the Bojana River have also enabled the introduction of some marine fish species into the lake's ichthyofauna. As a result, the lake hosts a rich diversity of fish, with nearly 48 species recorded so far. The exact number of fish species in the Lake Skadar basin has yet to be precisely determined, but current research has identified 30 native (autochthonous) species and 15 non-native (introduced) species.

Following species are classified as a IUCN critically endeared and also listed on Anex II of Bern convention as well as Annex II of Habitat directive: *Acipenser sturio*, *Acipenser naccarii*; *Alosa*

fallax, *Anguilla anguilla*. On Annex II Habitat directive is *Salmo marmoratus* (LC).

Salmo zetenesis is an endemic trout species found in Montenegro, specifically in the Zeta River basin. It belongs to the Salmonidae family and is and its been protected on national level.

In the context of herpetofauna, the Hermann's tortoise (*Testudo hermanni*), the European pond turtle (*Emys orbicularis*), and the four-lined snake (*Elaphe quatuorlineata*) are classified as Near Threatened (NT) and are listed in Annex II of the EU Habitats Directive. Furthermore, the Hermann's tortoise is included in the CITES list, which regulates international trade to prevent its exploitation and ensure its conservation.

The proposed Biosphere Reserve encompasses two RAMSAR Sites: Ulcinj Salina and Lake Skadar, both of which are of immense significance for wetland and bird conservation. These sites are recognized under the RAMSAR Convention, an international treaty aimed at the conservation and sustainable use of wetlands. They are crucial habitats for numerous bird species, especially migratory birds, and contribute to maintaining biodiversity in the region. Also, the proposed biosphere reserve is home of numerous IPA, IBA, EMERALD and KBAs site.

Lake Skadar, the largest lake in the Balkans, is another key RAMSAR Site located on the border between Montenegro and Albania. The lake and its surrounding wetland areas are vital for a wide variety of bird species, many of which are listed as threatened or endangered. It is recognized for its role in supporting large populations of waterfowl, such as the Pelecanus crispus (Dalmatian pelican), white-tailed eagles (*Haliaeetus albicilla*), and the Ferruginous Duck (*Aythya nyroca*). The lake's mix of freshwater and saline waters, along with its extensive reed beds, marshes, and islands, provides crucial breeding and feeding habitats for these birds. Lake Skadar is also a significant wintering site for many migratory species, including wildfowl and raptors. There are about 280 bird species living in Skadar Lake.

Ulcinj Salina is one of the most important wetlands in the Mediterranean and is known for its vast, shallow saline lagoons. This area plays a vital role as a stopover point for migratory birds along the East Adriatic flyway, providing a rich food source and safe resting spots during migration. The Salina is home to numerous bird species, including the Dalmatian Pelican (*Pelecanus crispus*), the Greater Flamingo (*Phoenicopterus roseus*), and various waders, such as sandpipers and plovers. It also supports a diverse range of other wildlife, including invertebrates, which are critical for sustaining the bird populations. The wetlands' unique ecosystem provides essential breeding, feeding, and sheltering areas for both resident and migratory birds. With around 250 bird species (Puzović 2002, Štumberger et al., 2005), birds are the most studied taxon in the

Salina (Ulcinj Salina) and throughout the entire Bojana River delta. Over 70 species recorded in this area are protected under the EU Birds Directive, which aims to safeguard vulnerable and endangered bird species and their habitats across Europe.

Ulcinj saline as a part of the proposed biosphere reserve is habitat for halophytes highly interesting plant covers. Typical or true halophytes (euhalophytes) can be found in habitats with high salinity and moisture levels. Their communities represent the dominant type of vegetation in Ulcinj Salina. *Salicornia herbacea* L. is the dominant species in this area.

The olive groves in Valdanos are one of the most significant and historically rich agricultural areas in proposed biosphere reserve. Located on the coast near the town of Ulcinj, the Valdanos olive groves are known for their ancient and traditional olive cultivation practices, which have been passed down through generations. These groves are particularly notable for their old olive trees, some of which are believed to be hundreds of years old.

5.2 Description of protection regimes exist for the core and buffer zones;

The proposed Biosphere Reserve contains two zones: core zone with the coverage of 6525,712 ha and buffer zone with the coverage of 66000,15ha.

The core area of the proposed Biosphere Reserve is cover 6525,712ha and it include the **first protection zone** of the National Park Lovćen, National park Skadar Lake, Monument of Nature Cijevna River Canyon, Nature Park "Rijeka Zeta" and Velika Plaža near Ulcinj. In Montenegro, the **Law on Nature Protection** establishes the legal framework for the creation and management of protected areas, including **protection zones**.

These zones are designated to preserve biodiversity, ecosystems, and natural resources. They are classified into different categories depending on the level of protection they require.

The **first protection zone** typically refers to the **strictest level of protection** within a protected area. This zone is meant to ensure the conservation of sensitive ecosystems and species, limiting human activities to a minimum to avoid disturbance. It often includes areas with critical habitats, rare or endangered species, and other environmentally significant sites. These zones are managed by relevant institutions like the **Public Enterprise for National Parks of Montenegro in case od National park Skadar Lake and National Park Lovćen** or other protected area management bodies in case of Cijevna River Canyon and Nature park "Rijeka Zeta".

In the following table is presented the core zone with the description:

Core zone	Description and International importance	Coverage
National Park Lovćen	The first zone of protection cover the broader area of Štirovnik and Jezerski Vrh incorporates previously defined nature reserves such as herpetological reserve. By integrating the existing nature reserves, this area ensures that critical habitats, including those of endemic species like *Pinus heldreichii* (Munika), are preserved and managed under strict conservation measures.	1577,53ha
National Park Skadar Lake – Spatial reserves of nature: Manastirska tapija and Pančeva oka	Manastirska tapija and Pančeva oka are spatial nature reserves. Pančeva Oka (Pancevo's Eye) It is one of the most valuable habitats for waterfowl in the region. Pančeva Oka is primarily a marshy area with dense reed beds, which provide shelter for various species of birds, fish,	2540,47

	and amphibians. It is a critical site for migratory bird species, especially during the winter and spring migrations. Pančeva Oka, a Special Reserve within Skadar Lake National Park, has been a key nesting site for Dalmatian Pelicans. To support their nesting, artificial platforms made of high-density polyethylene have been installed since 2014. These platforms help mitigate the loss of natural floating islands due to eutrophication and rising water levels. The introduction of these platforms has led to a notable increase in the pelican population in the area . The reserve is characterized by a mix of Mediterranean and continental plant species, making it a diverse ecosystem. The reserve is important for the protection of aquatic life, particularly the endangered fish species that are native to the lake's ecosystem. The surrounding landscape also supports wildlife, including various mammals, amphibians, and reptiles. Manastirska Tapija, located near the Vranjina Monastery, is another significant nesting area for Dalmatian Pelicans. The area is characterized by dense reed beds and willow vegetation, providing an ideal environment for pelican nesting. Conservation efforts in this region focus on habitat protection and monitoring to ensure the continued success of pelican breeding.	
Monument of nature - Cijevna River Canyon	The (first) protection zone includes **naturally unaltered areas on the steep slopes of the canyons** located between the (outer) boundary of the future protected natural area and the centrally positioned II and III protection zones, which follow the watercourse of the Cijevna River and areas occupied by settlements, infrastructure (roads and the Dinoša - State border with Albania), buildings, and agricultural land. Cijevna River Canyon PA is EMERALD site as well as part of the Green Belt. The absence of a designated Buffer Zone (Zone II) or Transition Zone (Zone III) surrounding Zone I (Core Area) may initially appear as a gap in the zonation structure of the biosphere reserve. However, this can be rationalized based on the unique geographical and ecological characteristics of the area. In the case of this specific core zone—comprised of steep canyon cliffs and rugged, largely inaccessible terrain—the surrounding landscape itself provides a	1783,37ha

	natural form of protection. These physical barriers limit human access and development, effectively functioning as a de facto buffer zone.	
Nature park "Rijeka Zeta".	The strict protection regime covers the **Moromiš wetland**, with an area of 0.15 km^2. Zeta river is also a part of the Green Belt.	15,11ha
Velika Plaža near Ulcinj	Velika Plaža has been designated as a protected natural reserve since 1968. It is also recognized as an **Emerald Site** under the Bern Convention, highlighting its importance for biodiversity conservation. Velika Plaža is recognized for its rich biodiversity and ecological significance. The area encompasses diverse habitats, including sandy dunes, brackish marshes, and remnants of floodplain forests. These ecosystems support a variety of plant species, some of which are rare along the Adriatic coast due to urbanization and tourist development.	609,22ha

The buffer zone with the coverage of **66000,15ha** encompasses the previously mentioned protected areas **with II and III protection zones**, excluding the core zones, as well as additional protected areas such as: *Nature Park Ulcinj Salina, Nature Park Komovi, the Nature Monument "Park Šuma Gorica," Nature Monument "Long Beach and Marine Buffer Zone of Ada Bojana."*

The **II protection zone** in protected areas in Montenegro represents a **moderate level of protection** aimed at maintaining the integrity of ecosystems, species, and habitats, while allowing certain controlled activities that do not pose a significant threat to the environment. This zone typically surrounds the **I protection zone** (which has the strictest protection) and extends outward, covering areas of significant ecological or landscape value, but where human activities are allowed under specific conditions.

The **III protection zone** in Montenegro represents an area with **a lower level of protection** compared to the first and second zones but still aims to preserve the ecological values and landscape features of the area. This zone is typically designed to provide a **buffer** around more strictly protected zones (first and second) and allows for a greater variety of human activities, provided they are sustainable and do not significantly harm the environment.

5.3 International designations (IPA, IBA, IFA, KBA, Ramsar, Emerald, etc.) and similar, within the BR

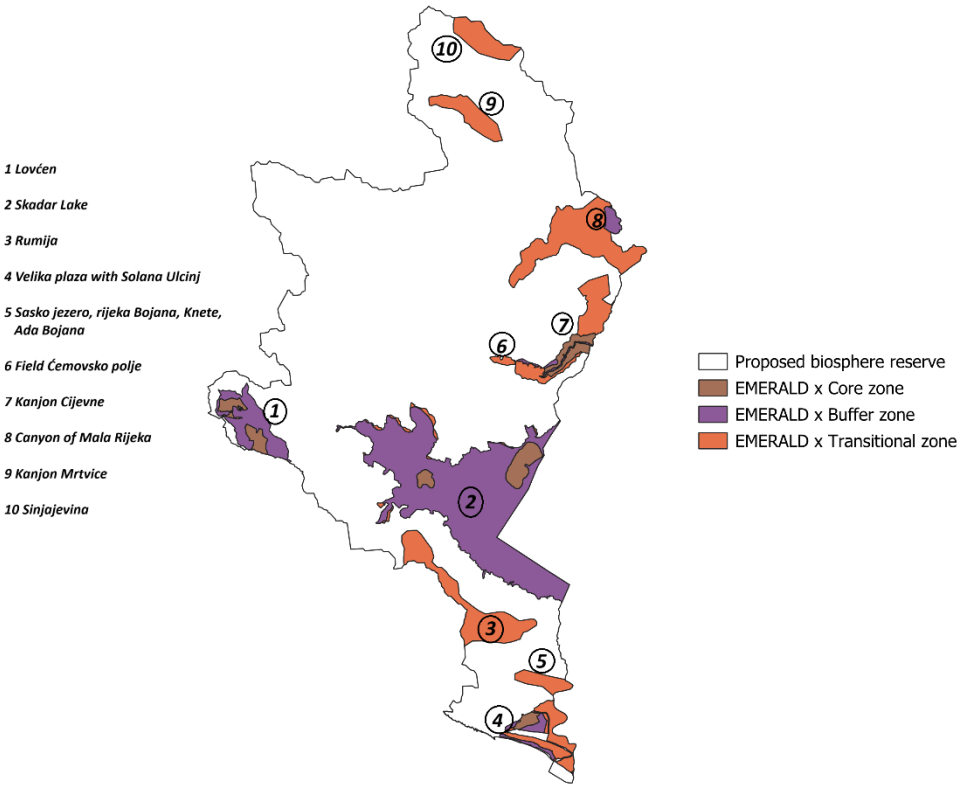
The proposed Skadar Lake Watershed Biosphere Reserve encompasses a total of 11 EMERALD sites, 11 Important Plant Areas (IPA), 12 Key Biodiversity Areas (KBA), and two Ramsar sites (Ulcinj saline and Skadar lake), highlighting its exceptional ecological significance and biodiversity value. Also, part of the proposed biosphere reserve is belonging to Green Belt.

The European Green Belt - with 12,500 km the longest green network in Europe - is an area of natural and cultural habitat that spans the entire European continent. Proposed Biosphere reserve with Cijevna, Zeta, Morača, Bojana River and Skadar lake is part of the European Green Belt.

5.3.1 EMERALD sites within the proposed Biosphere Reserve

The objective of this analysis is to determine the degree of overlap between potential Emerald sites in Montenegro and the proposed zones of the Skadar Lake Basin Biosphere Reserve. This analysis is conducted using QGIS software, performing a spatial overlap analysis between the Emerald Network and the core, buffer, and transitional zones of the biosphere reserve.

The Emerald Network represents a pan-European ecological network of protected areas, established under the Bern Convention, with the aim of conserving wild flora, fauna, and their natural habitats. Montenegro ratified the convention in 2009, and by 2011, it had nominated 32 sites for inclusion in the Emerald Network, covering approximately 17% of the country's territory.



Map 9 – Emerald sites and Proposed Biosphere reserve

For this analysis, spatial data in **ESRI Shapefile (SHP) format** are used, specifically:

- A polygon representing **potential Emerald sites in Montenegro**, and
- A polygon representing the **proposed zones of the Skadar Lake Basin Biosphere Reserve**.

Results of the Overlap Analysis:

1. **Core Zone – 97,59% Overlap** - The highest degree of overlap was detected in the core zone, indicating that the strictly protected areas of the biosphere reserve are also key Emerald habitats. The proportion of Emerald habitats within the core zone is **97,59%**, confirming the core zone as a vital ecological nucleus with the strictest protection regime, crucial for biodiversity conservation and habitat preservation.
2. **Buffer Zone – 61,56% Overlap** - The proportion of Emerald habitats within the buffer zone is 61,56%, emphasizing the buffer zone's role in protecting and preserving Emerald sites. Measures are necessary to prevent the negative impact of human activities in this zone to maintain key ecological values.
3. **Transitional Zone – 12.21% Overlap** - The lowest level of overlap was observed in the transitional zone, with only 12.21% of the area covered by potential Emerald habitats. Despite this lower percentage, the transitional zone remains essential for integrating sustainable development with biodiversity conservation.

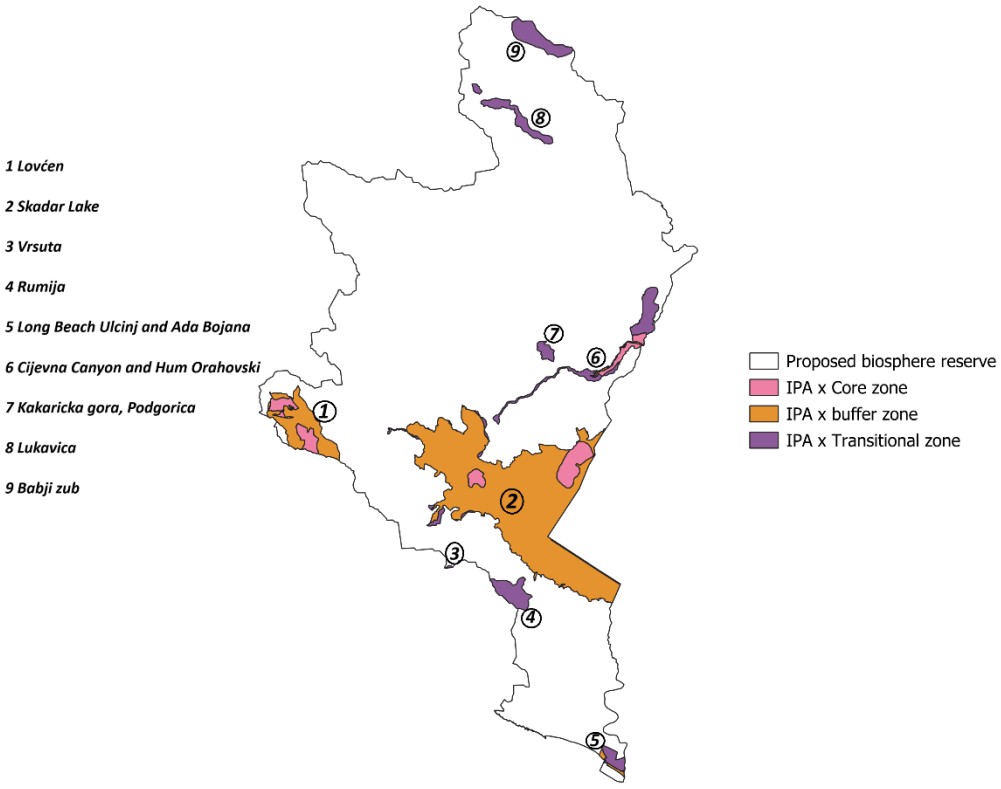
These findings underscore the importance of ensuring strong protection measures in the core and buffer zones while promoting sustainable management strategies in the transitional zone to support long-term conservation goals.

5.3.2 IPA Sites within the proposed Biosphere reserve

Montenegro, one of the most biodiversity-rich countries in Europe relative to its size, boasts an exceptionally rich flora, with over 3,250 vascular plant species, including many Balkan and Montenegrin endemics. Due to this, the identification and protection of Important Plant Areas (IPA) is crucial for biodiversity conservation.

Within the Proposed Biosphere Reserve there have been 11 **recognized IPA sites**, which are key for plant and ecosystem protection.

Analyzing the overlap between Important Plant Areas (IPA) and the zones of the proposed Skadar Lake Basin Biosphere Reserve is a key step in understanding the level of protection and conservation of rare and endangered plant species. IPA areas are globally significant for plant conservation, while the biosphere reserve consists of three zones: core, buffer, and transitional.



Map 10 – Important Plant Areas (IPA) and Proposed Biosphere Reserve

Methodology

The first step in the analysis involves data preparation and standardization. IPA layers and the biosphere reserve boundaries are loaded into GIS software, ensuring compatibility and coordinate system consistency. Geoprocessing is then conducted to determine which IPA areas spatially overlap with different biosphere reserve zones.

The overlap is analyzed separately for each biosphere reserve zone. Once spatial layers are intersected, the percentage of IPA area coverage within each zone is calculated.

Results of the overlap analysis:

The analysis results provide a clear insight into the ecological importance of specific biosphere reserve zones and can be used to enhance conservation measures. These findings serve as a basis for decision-making in spatial planning and management, aiming to protect plant species and natural ecosystems while enabling sustainable development in less sensitive areas.

1. **Core Zone – 76,08% Overlap -** Most key plant ecosystems are well protected within the core zone, which shows a high overlap of 84.08% with IPA areas. This confirms the core zone's vital role in safeguarding rare and endangered plant species.

2. **Buffer Zone – 58% Overlap** - The buffer zone, with an overlap of 58%, provides a positive foundation for the long-term conservation of flora. It acts as a natural buffer between strictly protected habitats and areas with higher human influence.
3. **Transitional Zone – 3.53% Overlap** The transitional zone shows minimal overlap (3.57%) but requires the application of sustainable development principles. This ensures that plant ecosystems within this zone are not degraded due to human activities.

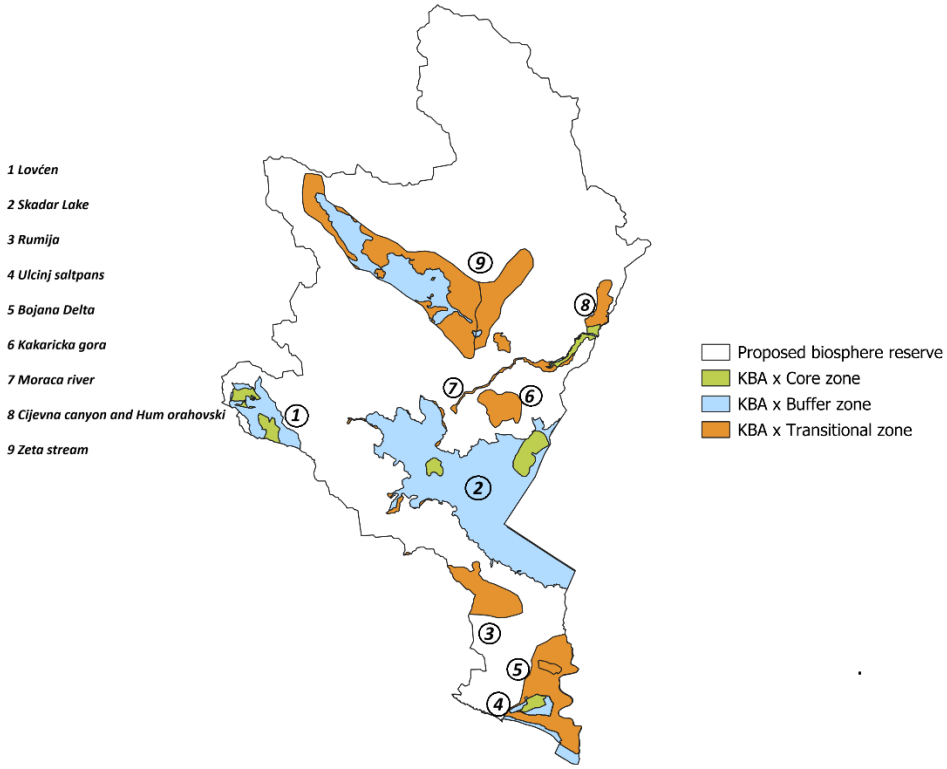
These findings highlight the importance of strict protection in core and buffer zones, while emphasizing the need for sustainable management in the transitional zone to balance conservation and development.

5.3.3 KBA Sites within the proposed Biosphere reserve

As part of international initiatives for nature conservation, Key Biodiversity Areas (KBA) in Montenegro have been identified as crucial sites for the preservation of rare, endangered, and endemic species, as well as the ecological processes that support their survival.

The KBA network in Montenegro includes several exceptionally important natural locations. These areas are essential for the conservation of specific plant and animal species, as well as their natural habitats. In proposed biosphere reserve there are nine KBAs.

This analysis examines the degree of overlap between Key Biodiversity Areas (KBA) and the proposed Skadar Lake Basin Biosphere Reserve.



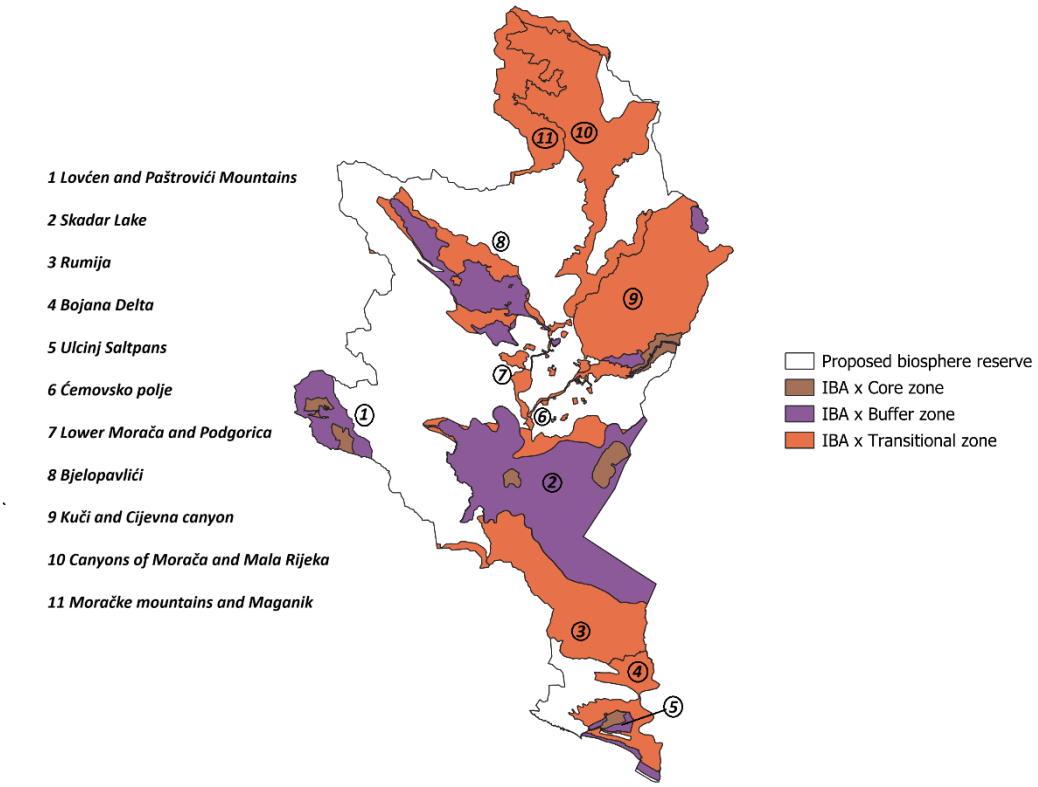
Map 11 – KBAs within the proposed biosphere reserve Skadar Lake Watersheld

The core zone has the highest degree of overlap with KBA areas (85,45%), confirming its crucial ecological value. Most strictly protected ecosystems and habitats of endangered species are located within this zone. The overlap with KBA areas indicates that these territories are of international significance for biodiversity conservation. The buffer zone, with 75,87% overlap, highlights its primary role in protecting the core zone by preventing negative impacts from surrounding areas. The transitional zone has the lowest degree of overlap with KBA areas (14%) and is designated for sustainable development and environmentally friendly economic activities.

5.3.4 IBA within the proposed biosphere reserve Skadar lake Watersheld

Montenegro, despite its small size, boasts rich biodiversity and a significant number of habitats crucial for birds. Currently, 11 Important Bird Areas (IBA) have been identified in Montenegro. Some of the most important ones, located within the proposed boundaries of the proposed biosphere reserve Skadar Lake Watersheld, include Lake Skadar, Ulcinj Salina, and the Bojana River Delta.

The conservation of IBA areas requires active engagement from the state, environmental organizations, and local communities to mitigate negative impacts such as urbanization, pollution, and poaching.



Map 12 – IBAs within the proposed biosphere reserve Skadar Lake Watersheld

Results of the overlap analysis:

Core zone: IBA areas cover 98.45% of this zone's total area, highlighting its exceptional importance for bird species and their habitats. This zone represents the most well-preserved part of the reserve, where human activities are minimized to ensure the uninterrupted development of natural ecosystems.

Buffer zone: IBA areas make up 93% of this zone, which serves as a transitional space between the strictly protected area and regions with limited human activities. This high percentage confirms the buffer zone's role in maintaining the integrity of IBA areas and reducing external negative influences.

Transitional zone: IBA areas account for 46,3% of this zone, which allows sustainable activities for local communities in accordance with nature conservation principles. Although the percentage of coverage is lower than in the previous zones, a significant portion of this area still plays a vital role in preserving bird habitats and offers opportunities for ecotourism and sustainable economic activities.

Within the proposed Biosphere Reserve, numerous areas have been internationally recognized as biodiversity hotspots, holding multiple conservation designations. For example, **Lake Skadar** is designated as a **Ramsar Site**, **Important Plant Area (IPA)**, **Important Bird Area (IBA)**, part of the **EMERALD Network**, and a **Key Biodiversity Area (KBA)**. Similarly, **Ulcinj Salina** is recognized as both a **Ramsar Site** and an **IBA**, while the **Cijevna River Canyon** holds **KBA**, **EMERALD**, and **IPA** status. **Lovćen Mountain** is also distinguished with **KBA**, **IPA**, **IBA**, and **EMERALD** designations. These overlapping international recognitions demonstrate that the ecological value of these areas extends well beyond the scope of national protection and underscores the need for a broader, more integrated approach to their conservation and sustainable management.

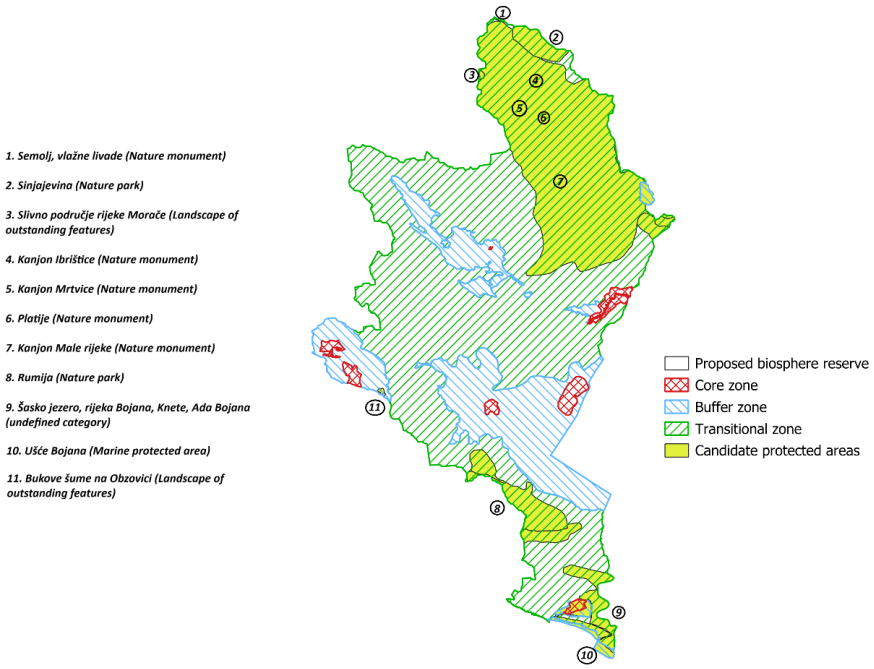
5.3.5. Future designation of protected areas in proposed Biosphere Reserve

By analyzing the spatial overlap between the boundaries of the proposed Biosphere Reserve and areas currently under consideration for national protection (According to the Draft of the Spatial Plan 2040), significant findings have emerged that indicate a high level of spatial alignment between national and international nature conservation objectives.

The adoption of the Spatial plan of Montenegro 2040 is expected soon. Considering the information used from the draft Spatial Plan 2040 there are potentially new protected areas to be designated and thus potentially increase the percentage, representation and distribution of the core and buffer zone of the future BR. These includes the following localities:

- Natural Monument "Canyon of the Mala Rijeka": 10,981.74ha
- Landscape of Exceptional Features "Beech Forests at Obzovica": 118.8 ha
- Landscape of Exceptional Features "Slivno Area of the Morača River": 83,788.91 ha

- Lake Šas, Bojana River, Knete, Ada Bojana (undefined category): 6404,42 ha
- Bojana River Estuary (marine protected area, up to the Albanian border): 0.07 ha
- Valdanos Bay (marine protected area, up to the boundary of "Stari Ulcinj" Nature Park): 2.06 ha
- Sinjajevina Nature Park: 3,299.58 ha
- Rumija Mountain Range Nature Park: 12,748.4 ha
- Natural Monument "Semolj": 39.52 ha
- Natural Monument "Torna (Bablji Zub)": 129.12 ha
- Natural Monument "Canyon of Ibrištica River": 335.55 ha
- Natural Monument "Platije": 2,311.21 ha
- Natural Monument "Canyon of Mrtvica River": 2,903.5 ha



Map 13– Candidate Protected Areas in the proposed biosphere reserve Skadar Lake Watersheld (Draft of the Spatial Plan 2040[3])

[3] https://biodiversitymontenegro.me/interaktivna-mapa/

5.3.6. Ongoing project initiative

Project: Fostering qualified protection of Morača river in MNE - By the end of the project, local, regional, national and international stakeholders and decision makers will have an agreement on the status and extent of protection of Morača River and its tributaries. The agreement will be based on mutual understanding and trust as well as the joint will to bring Morača River under qualified protection. Local stakeholders will have the willingness to actively contribute to the protection of Morača River, based on intrinsic motivation beyond economic interest. Project have started in 2025 and it will last three years.

Project "*Integrating Biodiversity into Sectoral Policies and Practices and Strengthening the Protection of Key Biodiversity Areas in Montenegro"* (GEF 7) began in March 2023 and is planned to last until February 2027. The GEF 7 project is geographically focused on Key Biodiversity Areas (KBA) in Montenegro, covering various interventions, including ecosystem protection and collaboration with productive sectors such as tourism, agriculture, and forestry.

The 4PETHABECO project, titled *"Strengthening Cooperation to Address Socio-Environmental Challenges within the EUSAIR Strategy"*, aims to improve coexistence between humans and large carnivores—such as bears, wolves, lynxes, and jackals—and to protect biodiversity and promote conservation. The project is led by the **University of Udine** (Italy), with nine partners from eight Adriatic-Ionian countries: Albania, Montenegro, Croatia, Greece, Italy, North Macedonia, Serbia, and Slovenia.

Project PA.CON is a continuation of the PA.CON (Protected Area Connectivity) initiative, aimed at enhancing ecological connectivity, sustainable development, and biodiversity conservation across protected areas in the Western Balkans. Within this framework, the integration of **PA.CON II** into National Park Lovćen (NP Lovćen) represents a strategic advancement in strengthening transboundary conservation efforts and ecosystem management in Montenegro. The objective of the project is to contribute to the development of sustainable tourism activities by strengthening the socio-economic situation and improving tourism services and infrastructure in the cross-border area across three project locations. The project is co-financed under the 1st Call of the Interreg VI-A IPA CBC Croatia – Bosnia and Herzegovina – Montenegro 2021–2027 Programme with funds from the ERDF and IPA III instruments of the European Union.

5.4 Threats and pressures on key species

(Identify main groups of species or species of particular interest for the conservation objectives and provide a brief description of the communities in which they occur based on the available data. What are the threats and pressures on those key species and what kind of measures and actions currently used to reduce those?)

The proposed Skadar Lake Watershed Biosphere Reserve is a biodiversity hotspot, home to a diverse range of bird, fish, and plant species. Its rich mosaic of ecosystems supports numerous endemic species and plays a crucial role in maintaining ecological balance and biodiversity conservation.

In this area many threats are recognized, such as: illegal fishing, illegal bird hunting, illegal forestry, natural resources exploitation, urbanization, pollution, invasive species, forest fires, small hydropower plants.

In the context of the conservation objectives it is important to mention fish species such as European eel (*Anguila anguilla*), *Acipenser sturio*, *Acipenser naccarii*; *Alosa fallax*, *Anguilla anguilla*. On Annex II Habitat directive is *Salmo marmoratus* (LC). *Salmo zetenesis* is an endemic trout species found in Montenegro, specifically in the Zeta River basin. It belongs to the Salmonidae family and is and its been protected on national level. The population of these species is declining, due to the **illegal fishing.** Illegal fishing practices, including the use of banned fishing methods like electricity and unauthorized nets, have been causing significant damage to the aquatic ecosystem. Efforts to combat illegal fishing in Lake Skadar have involved a combination of enforcement actions and community-based initiatives. Authorities from both Albania and Montenegro have been working together to strengthen monitoring and control measures, such as increased patrols, the introduction of penalties for illegal fishing, and the use of modern technology for tracking illegal activities. Additionally, environmental NGOs have been active in raising awareness and working with local fishermen to promote sustainable fishing practices.

However, more work is still needed to ensure the long-term preservation of Lake Skadar's biodiversity. A multi-faceted approach, including stricter enforcement, better education, and more effective cooperation between Albania, Montenegro, and local communities, will be key to addressing illegal fishing and ensuring the health of this unique and ecologically important lake.

When in comes to the fish population in Skadar Lake, it is important to mention the **dams on Bojana river in Albania**. The recent dams removal on the Bojana River in Albania represents a major environmental and ecological achievement, aimed at restoring the river's natural ecosystem and improving biodiversity in the region. The Bojana River, which flows between Albania and Montenegro, has long been a vital waterway for both countries, providing habitats for diverse species, supporting local fisheries, and serving as an important source of freshwater.

In the past, several dams were constructed along the river, which disrupted the natural flow of water, negatively impacted aquatic habitats, and reduced the river's ability to support local wildlife, especially migratory fish species. These dams also had adverse effects on the broader ecosystem, including water quality, sediment transport, and fish migration patterns.

The decision to remove these dams is part of a broader trend toward ecological restoration and sustainable river management. By dismantling these structures, the river is allowed to flow more naturally again, which is expected to have multiple benefits: restoration of fish migration, improvement of water quality, biodiversity recovery.

Another significant pressure directly impacting fish species and the entire aquatic ecosystem is **gravel and sand extraction.** These activities were highly intensive in the Morača and Cijevna rivers a few years ago. Although their intensity has decreased in recent years, they are still present and continue to pose a threat to the ecological balance of these rivers.

Small hydropower plants located on the Cijevna River in Albania could have a significant impact on the

Montenegrin side of the river, primarily due to the disruption of sediment transport. The retention of sediments behind dams can lead to riverbed degradation, increased erosion, and habitat loss downstream, negatively affecting aquatic ecosystems and species dependent on natural sediment flow. Additionally, dams can significantly alter ecological flow regimes, disrupting the timing, quantity, and quality of water necessary to sustain riverine biodiversity. In this context, governmental-level activities have been initiated by the United Nations Economic Commission for Europe (UNECE) to address these transboundary environmental concerns. These efforts aim to promote sustainable water resource management, mitigate the negative impacts of hydropower plants, and ensure the preservation of aquatic ecosystems in the Cijevna River basin. This is also crucial for transboundary cooperation and the proper assessment of the cross-border impacts of these projects.

Illegal bird hunting is an issue in Skadar Lake and Ulcinj Salina, two critical biodiversity hotspots in Montenegro. These areas serve as vital habitats for numerous migratory and resident bird species, many of which are protected under national and international conservation laws. Poachers often use decoys, traps, and night hunting techniques, which are illegal and highly destructive to bird populations. Despite legal protections, enforcement remains weak. However, the situation has significantly improved over the years, particularly with the implementation of hunting bans. Many poachers face minimal consequences, discouraging effective deterrence.

Invasive species – after the habitat loss, invasive species is the biggest threat to the biodiversity. In the proposed Biosphere Reserve there are numerous invasive plant species: *Amorpha fruticose, Aillantus altissima, Gleditchia tricanthos, Egeria densa, Elodea canadensis*. Also in Skadar lake there are fish invasive species such as *Gambusia sp*. Control and monitoring invasive species have to be done systematically. In Montenegro, much more needs to be done to address the issue of invasive species and their impact on biodiversity. While efforts have been made, the scale and complexity of the problem require more comprehensive, coordinated action at all levels—national, regional, and local. Proactive measures to control and prevent the spread of invasive species should be implemented.

Waste-water pollution – Wastewater pollution in proposed biosphere reserve is one of the most significant environmental challenges. The area is increasingly threatened by the discharge of untreated or inadequately treated wastewater. Wastewater pollution from urban, industrial, and agricultural sources negatively impacts the water quality. Podgorica, the capital city of Montenegro, faces significant challenges related to wastewater management and pollution. As the largest city in the country, with a growing population, managing wastewater effectively has become a critical concern to protect both the local environment and public health. The current wastewater treatment system in Podgorica was originally designed for a population smaller than the city's current population. As a result, the system is under significant strain, as it was not built to handle the volume of wastewater generated by the larger population now living in the city. This mismatch between infrastructure capacity and actual demand poses a range of challenges for both the environment and public health. The municipalities included in the proposed Biosphere Reserve, like Podgorica, also face ongoing challenges with wastewater treatment. Addressing these issues is a critical and urgent process that must be prioritized to ensure environmental protection and public health.

Forest fires – the proposed biosphere reserve is in the zone where is the very high risk of forest fires due to hot, dry summers and vegetation types conducive to fire spread. Recent amendments to the Law on Forests prohibit land use changes on burned forest land for 30 years to prevent exploitation of fire-damaged areas. Fighting forest fires in Montenegro presents significant challenges, largely due to limited resources, infrastructure. Unlike in some EU countries with strong volunteer fire traditions, Montenegro has seen a **drop in volunteer firefighter participation in country**, partly due to lack of funding, training opportunities, and public awareness.

Visitors in Protected area – In the proposed biosphere reserve, the primary goal of the national parks and protected areas is nature conservation; therefore, tourism should be considered a secondary activity. In this context, a high number of visitors may pose a threat to the protected areas. For that reason, it is both necessary and useful to conduct a **Visitor Capacity Analysis** to assess and manage the potential impacts of tourism on the natural environment. This is especially relevant for protected areas experiencing high visitor pressure, such as **Skadar Lake National Park.**

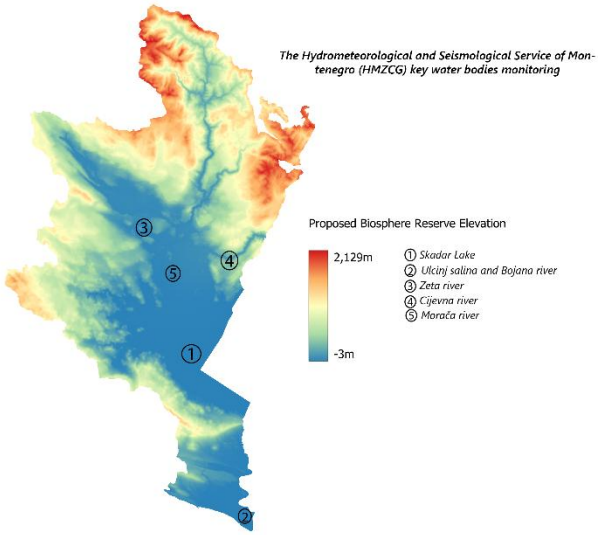
Urbanisation - lack of urban planning, illegal building and weak enforcement are the main threat to nature protection.

5.5 Monitoring programs and indicators used for conservation of the species and habitats in the BR

Monitoring programs in proposed biosphere reserve could be divided in the two points:

a) National monitoring which is done by the Hydrometeorological and Seismological Service of Montenegro (HMZCG) and Enviromental protection Agency - EPA;
b) Monitoring programs done by Protected Areas – mainly Public enterprise for National parks;

National monitoring - The Hydrometeorological and Seismological Service of Montenegro (HMZCG) is responsible for monitoring key water bodies, including Skadar Lake, the Bojana River, the Zeta River, the Cijevna River, the Morača River, the Tara River, and the lakes Krupac and Slano.



This annual monitoring program assesses the ecological health and status of these aquatic ecosystems by analyzing various parameters, including physico-chemical properties, pollutants, priority substances, and biological indicators. The primary goal of this monitoring is to achieve **Good Ecological Status (GES)** as defined by the **EU Water Framework Directive (WFD)**. Based on the directive, they are starting to introduce biomonitoring.

Monitoring in protected areas – Protected areas in Montenegro in the context of management can be diveded in two categories: national parks and the protected areas with a lower level of protection: nature parks, monuments of nature. National parks cover approximately 8% of Montenegro's territory and are managed by the Public Enterprise for National Parks. Areas with a lower level of protection—such as nature parks and natural monuments—are managed by enterprises established by local municipalities.

Montenegro has a long tradition in the management of protected areas, with its first national parks established in 1952. Despite this extensive experience, there is still a lack of standardized monitoring programs and protocols that can be uniformly applied across all national parks. Establishing protected areas with lower level of protection such as nature parks has been starting in the last 10 years.

In the context of monitoring, there are no standardized protocols that can be applied to all national parks in Montenegro. Each park develops its own protocols and conducts monitoring based on its

specific ecosystems and species. Proposed biopshere reserve include two national parks: Skadar lake and Lovćen.

When it comes for the implementation of monitoring protocols and linking it with the conservation objectives and measures, there are limited activities in that sense and there are have been implementing in PA such as NP Skadar Lake and NP Lovćen. The main lack is that missing defined conservation objectives for certain species.

In the following text it will be described monitoring programs and activities performed in the aim of conservation: **NP SKADAR LAKE**

FLORA

Marsilea quadrifolia and Caldesia parnassifolia

The monitoring of the rare plant species *Marsilea quadrifolia* and *Caldesia parnassifolia* have been conducted on annual basis. Both species are rare and endangered in Montenegro and across Europe (IUCN Red List, EU Habitat Directive Annex IIb and Annex IVb, Bern Convention Annex I). There is a defined methodology which is used for monitoring. Monitoring data's have been used to assess the population and trends.

Quercus robur scutariensis

In the area of the Skadar Lake National Park, the focus of monitoring is directed towards two key forest species: the Skadar oak (*Quercus robur ssp. scutariensis*) and laurel (*Laurus nobilis*). Monitoring protocol for *Quercus robur scutariensis* have been developed by GIZ and it have been implementing by NP.

Monitoring of **invasive species**, including aquatic invasives, is ongoing within Skadar Lake National Park, where several non-native species have already been recorded. However, the absence of a standardized monitoring protocol remains a significant challenge for effective management. In response, action plans for the control of specific invasive species—such as *Amorpha fruticosa, Egeria densa,* and *Elodea canadensis*—were developed earlier this year.

Some of the proposed control measures and management activities outlined in these plans are expected to be integrated into the new Management Plans for Skadar Lake National Park, which are currently in preparation. This represents a positive step toward more structured and coordinated management of invasive species in the park's sensitive ecosystems.

ORNITHOFAUNA

Monitoring of ornithofauna in NP Skadar lake is defined by the program, which focuses on the following parameters: abundance, distribution, population vitality, and the degree of endangerment.

In that sense, it has been conducted a **winter census of waterbirds** as part of the IWC (International Waterbird Census) monitoring. Also, it is conducting monitoring during the spring and summer seasons assessed the level of endangerment of **colonial species**, with special attention given to nesting species in special nature reserves. A year-round monitoring of the

Dalmatian pelican (*Pelecanus crispus*) is also being carried out.

The status of indicator bird species and their populations was monitored according to already established protocols. The following species were monitored:

- **White-winged Tern** (*Chlidonias hybridus*) – Red List of Montenegro NT, European Red List LC, EU Birds Directive Annex I
- **Great Cormorant** (*Phalacrocorax carbo*) – Red List of Montenegro NT, European Red List LC
- **Pygmy Cormorant** (*Microcarbo pygmaeus*) – Red List of Montenegro NT, European Red List LC, EU Birds Directive Annex I
- **Dalmatian Pelican** (*Pelecanus crispus*) – Red List of Montenegro VU, European Red List LC, EU Birds Directive Annex I
- **Great Crested Grebe** (*Podiceps cristatus*) – Red List of Montenegro NT, European Red List LC
- **Grey Heron** (*Ardea cinerea*) – Red List of Montenegro VU, European Red List LC
- **Common Pochard** (*Aythya ferina*) – European Red List VU, EU Birds Directive Annex II a and III b
- **Ferruginous Duck** (*Aythya nyroca*) – Red List of Montenegro EN, European Red List LC, EU Birds Directive Annex I

The big effort in monitoring bird activities is done by NGO Center for research and protection of birds – CZIP. CZIP conducts detailed surveys of breeding bird populations in wet meadows, focusing on species such as the **White-winged Tern (*Chlidonias leucopterus*)** and the **Mallard (*Anas platyrhynchos*)**. These surveys provide critical data on reproductive success and habitat preferences.

Center for Protection and Research of Birds (CZIP) also have several ringing stations (Mareza, Shas lake) Beside bird ringing, the scheme is conducting telemetry research where it is managed to track migratory and non-migratory birds such as Short-toed Snake eagle, Glossy Ibis, Rock Partridges, Western Capercaillie etc.

MAMMALS

The monitoring of otter (*Lutra lutra*) presence has been continuously conducted since 2011, based on traces of its presence (most commonly feces). The applied method involves recording traces within 5x5 km quadrants, meaning that every 5 km, a search is conducted for a suitable location for potential marking. There is developed Monitoring protocol. The otter has been recorded along the entire shoreline of Skadar Lake National Park, and a map has been created to document its distribution. There is no data's about the abundance.

The bat fauna (Chiroptera) has been studied through the national project *"Mapping of Species and Habitats for the Establishment of the Natura 2000 Ecological Network in Montenegro"*, implemented

by the Environmental Protection Agency. A total of 10 Natura 2000 bat species have been recorded: *Rhinolophus hipposideros, Rhinolophus ferrumequinum, Rhinolophus euryale, Rhinolophus blasii, Myotis myotis, Myotis blythi, Myotis emarginatus, Myotis capaccinii, Myotis nattererii,* and *Miniopterus schreibersii.* There is no developed monitoring protocols for bat fauna.

AMPHIBIANS AND REPTILES

There are developed monitoring protocols for following species: *Pelophylax shqipericus, (Bombina variegata)* but it has not been followed. There have been done monitoring for certain transect and reported. Systematic monitoring using developed monitoring protocols is missing as well as measurable conservation objectives.

FISH MONITORING

Monitoring of fish species in Montenegro is conducted by the University of Montenegro, Faculty of Natural Sciences, at the request of the Ministry of Agriculture, Forestry, and Water Management. Specifically, in 2022, the document titled *Fish Base for Rivers Morača, Zeta, Cijevna, and Rikavačko Lake* was prepared. This document outlines the findings regarding the fish populations in these water bodies and proposes concrete measures aimed at their preservation and management.

The proposed measures, based on the findings of the monitoring, are designed to support sustainable fish populations and improve the ecological health of the rivers and lake. These measures are to be implemented by Sport Fishing Clubs, which hold a six-year concession for river management. The similar situation is with NP Skadar Lake, the difference is in the implementation of measures that in this case is performed by National Park Skadar Lake.

Monitoring focuses on ecologically and economically important species such as carp, bleak (uklјeva), and eel. - Based on monitoring results[4], the Ministry of Agriculture, Forestry, and Water Management extended the fishing ban (closed season) for bleak in 2025, from February 1st to October 31st, to allow population recovery.

FOREST MONITORING

The forests within national parks are classified as "forests of special purpose" under the Law on National Parks. These forests hold exceptional natural value and are primarily designated for scientific research, education, and recreational activities.

In addition to their ecological and scientific importance, forests within national parks play a crucial role in addressing climate change. They serve as carbon sinks, mitigate the effects of extreme weather conditions, and contribute to biodiversity conservation. However, they are also increasingly exposed to threats such as wildfires, pests, and other environmental pressures, necessitating effective management strategies to ensure their long-term stability and resilience.

Forests located outside the boundaries of protected areas are managed by *Uprava za šume* (the Forest Administration). These forests are essential for sustainable resource management,

[4] https://nparkovi.me/news/145/izmjenama-naredbe-lovostaj-na-ukljevu-u-np-skadarsko-jezero-od-1-februara-do-31-oktobra

economic activities, and maintaining ecological balance. While they may not have the same level of protection as those within national parks, they still contribute significantly to biodiversity conservation, soil protection, and climate regulation.

In the last decades, there were *concession system of forest management* in Montenegro. A forestry concession is essentially a contract between the government and a private company or individual, granting the right to use forest resources for a specified period under regulated conditions.

The concession system of forest management in Montenegro has faced significant challenges over the past decades, leading to serious problems in the forestry sector. While the system was intended to promote sustainable use of forest resources and economic development, its implementation has often resulted in negative consequences.

In December 2024, the Government of Montenegro adopted a new Law on Forests, officially abolishing the previous concession-based system of forest management. This legislative change aims to address longstanding issues such as overexploitation, illegal logging, and loss of state revenue associated with the concession model. However implementation that should started in 2025 is at stake.

Forest monitoring in Montenegro is carried out by different institutions depending on the level of protection of the forested area. The goal of monitoring is to ensure sustainable forest management, prevent illegal activities, and protect biodiversity.

Forests Outside National Parks - Monitoring is conducted by Uprava za šume (Forest Administration). Responsibilities include overseeing sustainable logging, preventing illegal activities, and ensuring compliance with forestry laws. The Forest Administration carries out national forest inventories at regular intervals, also monitoring focuses on **pathological and entomological conditions.** The Forest Administration oversees **forest management units**, ensuring compliance with forest management plans, logging permits, and implementation of protection measures.

Forests Within National Parks - Managed and monitored by Public enterprise for National parks. Focus is on conservation, scientific research, and biodiversity protection. Stronger restrictions apply, with minimal human intervention allowed. Forest monitoring within national parks is carried out based on Baseline Studies for Forest Management, as is the case with National Park Lovćen. In addition, monitoring of pathological and entomological conditions is conducted to assess forest health. Based on the findings, appropriate protection and management measures are planned and implemented.

Forests Within Nature Parks *(Lower Protection Category)* - Although Nature Parks have a protected status, they fall under a lower level of protection compared to National Parks. Monitoring is carried out dominantly by Uprava za šume (Forest Administration). Sustainable use is permitted, but conservation measures must still be followed.

In the proposed biosphere, forest are dominantly located in NP Lovćen and Nature park Komovi.

Forests cover 67% of the area (4,189 ha) and represent the dominant ecosystem in NP Lovćen. Beech forests (*Fagetum montenegrinum montanum*) dominate, present with three *subassociations - F. montenegrinum sesleriesosum, F. montenegrinum viburnetosum, and F. montenegrinum subalpinum*.

In the past, diverse forests of beech, maple, and Macedonian pine grew over a larger area, but due to various and prolonged anthropogenic impacts, they have been significantly devastated and are now mostly concentrated in the narrower zone of the Park.

The area of beech forests is discontinuous and often interrupted by grazing stone fields of the Genisto-Globularietum belidifoliae community, which formed as a result of the degradation of the beech forest. The endemic species *Pinus heldreichii* (Macedonian pine) grows on the highest peaks – Štirovnik and Jezerski Peak (individually or in groups). Macedonian pine was much more widespread here in the past, but its presence drastically decreased due to logging.

Forest monitoring in NP Lovćen involves tracking changes in forest composition, health, and biodiversity over time. This includes assessing tree species distribution, detecting signs of disease or pest infestations, and analyzing the effects of climate change and human activities. Given the park's rich biodiversity and ecological importance, regular monitoring helps in conservation efforts, sustainable forest management, and the protection of endemic and rare species. In NP Lovćen, forest ecosystem monitoring is done according to the Baseline Study for Forest Management.[5] The monitoring recorded the complete drying out of black pine plantations in the Blatište area. The biggest challenge in restoration is the inability to secure autochthonous beech planting material of adequate provenance.

Forest monitoring should be also done in **Nature park Komovi**, but due to the lack of capacities of managers of this PA it has not been done.

HUNTING

Hunting in Montenegro is regulated by laws that promote sustainable wildlife management and conservation. The country boasts diverse ecosystems, making it home to various game species, including deer, wild boar, and birds.

The organization of hunting is overseen by the Ministry of Agriculture and Rural Development, which establishes hunting regulations, seasons, and quotas. Hunting grounds are typically managed by hunting associations or clubs, which are responsible for ensuring that hunting practices align with conservation efforts. Additionally, hunting organizations and associations play a significant role **in monitoring species populations** within designated hunting areas. They are involved in data collection, assessing the health of animal populations, and implementing conservation measures.

[5] Izvještaj o realizaciji godišnjih planova upravljanja JPNPCG 2022

In the proposed Biosphere Reserve, monitoring protocols for certain species and species groups are primarily implemented by National Parks Skadarsko Jezero and Lovćen. However, designated protected areas categorized as Nature Parks, such as Ulcinj Salina and Nature Park Dolina Rijeke Zete and Cijevna River Canyon, currently lack established monitoring activities due to the lack of established management bodies.

In the case of **Ulcinj Salina**, it is important to note that monitoring protocols have been developed for various species groups and key indicator species by NGO Centar for research and protection of birds – CZIP / Birdlife Montenegro:

- *Monitoring protocols for phytobenthos*
- *Monitoring protocols for Charophytes*
- *Monitoring protocols for Bryophytes*
  Monitoring protocols for plant species:
    - *Aster squamatus*
    - *Cynodon dactylon*
    - *Erigeron canadensis*
    - *Erigeron annuus*
    - *Xanthium italicum*
- *Monitoring protocols for indicator species of:*
    - *Invertebrates*
    - *Mammals*
    - *Birds*
    - *Herpetofauna*
    - *Fish*

However, their implementation has been delayed due to the prolonged process of establishing a management authority for this protected area. As a result, systematic biodiversity monitoring has yet to take place, limiting efforts to track and protect the site's ecological values effectively.

Similarly, **Nature Park Dolina Rijeke Zete and Cijevna River Canyon** faces the same challenge. NGO Environment Programme has developed *Monitoring protocols for indicator invertebrate species* in Nature Park "Dolina rijeke Zete" but sustainability and ownership has been delayed due to the prolonged process of establishing a management authority for this protected area. Despite its designation as a protected area, the absence of an appointed management body has hindered the development and execution of essential monitoring activities. Without an official entity responsible for conservation and oversight, the park lacks structured biodiversity assessments, making it difficult to address potential environmental threats and ensure the long-term protection of its natural resources.

Addressing these administrative gaps is crucial to implementing effective conservation measures and ensuring that both **Ulcinj Salina, Zeta River Valley, Cijevna River Canyon** receive the necessary ecological monitoring and protection in line with their conservation status.

It is also crucial to highlight the contributions of civil society organizations (CSOs) and international organizations in the preparation and development of monitoring protocols, both for species groups and individual species.

Species important for genetic diversity

(If available, present current species or varieties important for genetic diversity and measures used to conserve genetic diversity and practices associated with their conservation. If there are gaps in this topic, kindly state.)

The proposed biosphere reserve with its diverse ecosystems ranging from coastal areas to mountainous regions, is home to a rich variety of species, contributing to its significant genetic diversity. Proposed biosphere reserve is home to numerous endemic species, especially in the flora and fauna. This includes plants like the Montenegrin pine (*Pinus peuce*), and species like *Salmo marmoratus* (marbled trout) and *Salmo zetensis* (Zeta trout). (*Edraianthus wettsteinii*), found exclusively on Lovćen Mountain, *Pinguicula hirtiflora* found in Cijevna River Canyon. In this context it is worth mentioning the recent research findings and discover a new genus and species in this region: *Petrolamium crnojevici* . These species are genetically unique, having evolved over millennia in isolated habitats. Their conservation is critical to maintaining genetic diversity within the country. When it comes to pressures on these unique species, several threats are particularly concerning. **Illegal fishing** poses a serious risk to endemic fish such as *Salmo marmoratus* (marbled trout) and *Salmo zetensis* (Zeta trout), threatening their already limited populations. The **planned quarry development** near the habitat of the newly discovered species *Petrolamium crnojevici* could endanger this plant unless strict protective measures are implemented.

The rare plant *Pinguicula hirtiflora*, known from only a single location in the **Cijevna River Canyon**, suffered significant loss when a **new road destroyed its only known population**. Fortunately, a second population was recently discovered in the same canyon, offering a renewed opportunity for its conservation.

One of the most effective measures for conserving genetic diversity is the establishment of protected areas. In Montenegro, there is a trend of proclaiming new protected areas but the problem is the management of these protected areas.

Ex situ conservation refers to the preservation of species outside their natural habitats. This is commonly done through gene banks, seed banks, zoos, and botanical gardens. In Montenegro there are botanical gardens such as: Arboretum Grahovo, Botanical Garden Kolašin, and Botanical Garden Velemut. These locations are outside of the proposed biosphere reserve.

Efforts to collect and preserve Montenegro's genetic resources began in the 1940s, focusing on vines, fruits, and wheat. A structured national approach began in 1987 but suffered setbacks due to the 1990s war and the dissolution of Yugoslavia. The **Agricultural Institute in Podgorica** (now the Biotechnical Faculty) became the custodian of remaining genetic material, although limited funding led to significant losses.

Between 2001–2006, expeditions by the Faculty of Agriculture in Novi Sad collected wild wheat relatives to study their genetic makeup. A major milestone occurred in 2004 with the launch of the **SEEDNet**

Project, funded by the Swedish International Development Agency (Sida). This regional initiative aimed to conserve and sustainably use plant genetic resources across 12 Southeast European countries.

The project established the **Montenegrin Gene Bank (MGB)** at the Biotechnical Faculty in Podgorica. Equipped for long-term seed storage and genetic research, MGB follows international standards (IPGRI). The project revitalized genetic resource management, though the number of accessions remains limited.

The proposed biosphere reserve is also recognized by vineyards. In the last decade there have been genetic research of grapevine (*Vitis vinifera*). The study published in the prestigious journal *Nature Scientific Reports* by a multidisciplinary team from Montenegro, Canada, and Spain sampled and genotyped over 500 ancient grapevines, over 100 years old, from various regions of Montenegro, determining their genotype and genetic relationships.

This study uncovered an unexpected diversity of grapevine genotypes, with 51 previously unknown genotypes identified, representing new grapevine varieties. However, the most significant discovery was the identification of their genetic relatedness and the unveiling of the pedigree of Montenegrin grapevines.

This study demonstrates that grapevine cultivation in Montenegro has a long history, with a unique genetic structure specific to this wine-growing region.

6. BIOCLIMATIC REGION

The proposed biosphere reserve, based on the aridity index, is located in the per-humid zone. Detailed calculation is presented in the table bellow:

Areas	Average annual rainfall/mm	Aridity index		Core area(s)	Buffer zone(s)	Transition area(s)
		Penman	(UNEP index)			
Hyper-arid	P<100	<0.05	<0.05			
Arid	100-400	0.05-0.28	0.05-0.20			
Semi-arid	400-600	0.28-0.43	0.21-0.50			
Dry Sub-humid	600-800	0.43-0.60	0.51-0.65			
Moist Sub-humid	800-1200	0.60-0.90	>0.65			
Per-humid	P>1200	>0.90		Per-humid	Per-humid	Per-humid

Meteorological station	Average annual precipitation P (mm)	PENMAN ETo (Average annual value in mm/day	Aridity index AI= P/ETo
Ulcinj	1274	3.3	1.06 (Per-humid)
Bar	1371	3.9	0.96 (Per-humid)
Podgorica	1515	4.1	1.01 (Per-humid)
Nikšić	1934	2.4	2.21 (Per-humid)
Kolašin	2081	3.1	1.84 (Per-humid)

7. ELEVATION

The analysis of terrain and elevation aims to determine the altitudes within the boundaries of the proposed biosphere reserve using EU DEM 30 data. The spatial overlay of the raster layer of the digital elevation model (DEM) and the vector layer of the proposed reserve boundaries enables the extraction of relevant data on elevation and terrain characteristics of the analyzed area.

Lowest elevation: -3 m
Highest elevation: 2129 m

8. ECOSYSTEM SERVICES

Currently, there are no specific research activities related to ecosystem services in the planned UNESCO Biosphere Reserve Skadar lake Watersheld. In the following, the ecosystem services are listed in a summarized overview in key points and a qualitative manner. According to the nomination requirements, the ecosystem services are divided into groups based on the Millennium Ecosystem Assessment. The descriptions do not reflect a comprehensive analysis of ecosystem services as no such analysis has yet been carried out.

- **Provisioning Services**: These are the products obtained from ecosystems, including food, water, timber, fuel, and medicinal plants.
- **Regulating Services**: These are the benefits obtained from the regulation of ecosystem processes, such as climate regulation, disease control, water purification, and flood regulation.
- **Cultural Services**: These refer to non-material benefits that people obtain from ecosystems, such as recreational, spiritual, educational, and aesthetic experiences.
- **Supporting Services**: These services are necessary for the production of all other ecosystem services. They include processes like nutrient cycling, soil formation, and primary production.

Assessment and Identification of Ecosystem Services

The first step in accessing ecosystem services is to identify which services are provided by a particular ecosystem.

Provisioning services

Freshwater Supply (for drinking, irrigation, and industry) – The proposed Biosphere Reserve Skadar Lake Watershed plays a crucial role in the provision of freshwater supply, supporting both human populations and ecosystems. Skadar Lake and the Morača River serve as the primary sources of drinking water, supplying the entire coastal region of Montenegro. A key freshwater source is the Bolje Sestre Spring, located near Skadar Lake, which provides drinking water to much of the Montenegrin coast, including the municipalities of Bar, Budva, Tivat, and Kotor. This spring is considered one of the most significant groundwater sources in the country.

Additionally, the Mareza Springs, located within the Nature Park of Dolina rijeke Zete, provide a significant portion of Podgorica's drinking water. This area is of particular ecological importance due to its rich wetland habitats and unique hydrological features.

The Cijevna River and its associated springs are crucial for the municipality of Tuzi, ensuring a reliable water supply for both residential and agricultural use. Furthermore, Plantaža AD, one of Montenegro's largest agricultural and wine-producing companies, relies on underground water from the Cijevna River for irrigation of its extensive vineyards. This highlights the importance of sustainable water management, as both local communities and key industries depend on these resources.

Irrigation - in addition to providing drinking water, these freshwater sources are used for irrigation. The agricultural lands surrounding Skadar Lake, as well as the agricultural lands in Zeta, Tuzi, Bjelopavlici, depend on these water systems for irrigation, ensuring the cultivation of key crops such as vineyards, fruits, olive and vegetables. The availability of water from these sources directly influences agricultural yields and food security in the region.

Food - The proposed Biosphere reserve provides a very important food supply through its rich natural resources and agricultural landscapes. As a key ecosystem service, the region supports a diverse range of food production systems that benefit both local communities and the national economy.

Fisheries - Skadar Lake, the largest lake in the Balkans, is a key area for commercial and traditional fishing. The lake is home to more than 40 fish species, including several endemic and migratory species. Fishing is not only an economic activity, but has a distinct social component and represents a way of life for the local population. Commercial fishing on Lake Skadar is based on the fishing of several species, of which carp, bleak, and eel are the most important and for which demand on the market is high. **Food (vegetables, fruit, vine, olive, mushrooms, berries, honey)**– the proposed biosphere reserve is among the most fertile areas in Montenegro. These lands support grains, vegetables, fruit, vine and olive production, ensuring a steady supply of locally grown food. The region is well-known for its vineyards and fruit plantations, with Plantaža AD being one of the largest wine producers in the country. Olive groves, fig trees, and other

Mediterranean crops thrive in the area's favorable climate. Mushrooms, berries and wild herbs collected in nature also serve as food. Honey is also produced by local beekeepers.

Milk, meat, cheese, and wool is produced due to the pastoral farming which is agricultural practice in proposed Biosphere reserve Skadar Lake Watersheld, contributing not only to the local economy but also to the cultural identity and sustainability of these regions. Livestock farming in these areas supports the production of milk, meat, cheese, and wool, and contributes to food security.

Wood - has been exploited for heating in Rumija mountain, hinterland of Ulcinj. In the Komovi Mountains wood is extracted for commercial use, mostly illegally. This illegal exploitation of timber has raised concerns regarding the sustainability of local forests and the potential environmental impact on biodiversity and ecosystem health in the region.

Gravel and sand in the proposed Biosphere Reserve—particularly in the Morača and Cijevna Rivers—provide a wide range of critical ecosystem services, from habitat creation and water filtration to flood regulation and erosion control. However, Both the **Morača** and **Cijevna Rivers** are facing growing pressure due to the unregulated and **unsustainable extraction** of sand and gravel.

Regulating and supporting services

The **wetlands**, **marshes**, **riparian** and **forest zones** in proposed Biosphere reserve act as natural filters, removing pollutants and sediments from the water. The vegetation, especially the aquatic plants in the lake, helps to purify water by absorbing excess nutrients like nitrogen and phosphorus, which can lead to eutrophication (over-enrichment of water with nutrients). This helps maintain the water quality of the lake and rivers, which is crucial for both drinking water supply and aquatic life.

Above mentioned ecosystems help regulate **flooding** by acting as natural **sponges**. These areas absorb excess water during heavy rains, slowing down the flow of water into surrounding areas, reducing the risk of floods and protecting local communities and agriculture.

The forests, peatlands, wetlands within the Skadar Lake Watershed play a vital role in the carbon cycle by acting as carbon sinks. The vegetation absorbs and **stores carbon dioxide (CO2),** helping to mitigate the effects of climate change. Forest ecosystems, especially in the Lovćen National Park and Komovi Mountains, store large amounts of carbon in both trees and soil, reducing the concentration of greenhouse gases in the atmosphere.

The proposed biosphere reserve encompasses a wide range of habitats that support numerous plant and animal species, many of which are essential for the survival of pollinators. These species provide food, nesting sites, and shelter for pollinators such as bees, butterflies, and other insects, which in turn contribute to biodiversity, food production, and ecological balance.

Sand dunes on Long beach and Ada Bojana - act as natural barriers against **storm surges, high tides, and coastal erosion**, protecting inland ecosystems and human infrastructure. Dunes stabilize the **land surface** and reduce wind erosion in arid and coastal environments.

Sand dunes provide critical **habitats for specialized plants and animals**, many of which are endemic or endangered.

Cultural ecosystem services refer to the non-material benefits that people derive from nature, such as recreation, spiritual enrichment, aesthetic enjoyment, cultural heritage, and a deep sense of place and identity. The proposed Biosphere Reserve in Montenegro offers a wealth of these cultural ecosystem services, reflecting a strong and enduring connection between local communities and their natural environment. This region is not only ecologically significant but also culturally rich, where landscapes are deeply embedded in the traditions, history, and identity of the people.

Lovćen Mountain and Lake Skadar are especially symbolic, representing the cultural and natural heart of Montenegro. Lovćen is more than a national park—it is a sacred mountain, home to the Mausoleum of Petar II Petrović Njegoš, a revered poet and national leader, and a site of pilgrimage and pride for Montenegrins. The mountain's dramatic landscape, traditional villages, and historic paths evoke a strong sense of national identity and continuity with the past.

Lake Skadar, the largest lake in the Balkans, is not only a biodiversity hotspot but also a cradle of cultural heritage. Scattered around and within the lake are ancient monasteries, island fortresses, traditional fishing settlements, and sacred sites that reflect centuries of coexistence between people and nature. Traditional fishing techniques and lakeside gastronomy remain vital elements of cultural life and rural tourism. Sports and recreational fishing in proposed Biosphere Reserve is popular both among local residents and tourists. Popular destinations are Lake Skadar and the most popular rivers for sports and recreational fishing are Tara, Morača, and Lim. Brook trout (*Salmo fontinalis*), huchen (*Hucho hucho*), grayling (*Thymallus thymallus*), and marble trout (*Salmo marmoratus*) are among the common species caught.[6]

At the center of this cultural landscape lies Cetinje, the historic royal capital of Montenegro. As the country's old capital, Cetinje is home to important cultural institutions, including museums, monasteries, and former royal residences. The town has long served as a symbol of Montenegrin statehood, spirituality, and resistance, and continues to embody the country's cultural legacy. Surrounded by mountains and karst valleys, Cetinje connects the spiritual heritage of Lovćen with the broader narrative of national identity rooted in the natural landscape.

The southern coastal region proposed biosphere reserve, encompassing Rumija mountain, Long beach, Ulcinj Saline and Ada Bojana, is not only known for its exceptional natural beauty and ecological richness, but also for its deep cultural and historical significance. Ulcinj is one of the oldest towns on the Adriatic coast, with a history spanning over 2,000 years. It has been shaped by Illyrian, Roman, Venetian, Ottoman, and Albanian influences, making it a unique cultural mosaic. Ulcinj's Old Town, mosques, churches, and historic fortifications reflect a rich multicultural history that continues to shape local identity and community life. Ada Bojana is a triangular river island formed at the mouth of the Bojana River. Ada Bojana is internationally recognized as a place of personal freedom, artistic expression, and alternative tourism, attracting

[6] https://eurofish.dk/fisheries-and-aquaculture-in-montenegro/

visitors seeking spiritual and cultural escape. The area is famous for its *kalimera*—traditional stilt fishing huts—still used today, symbolizing sustainable living and harmony with nature.